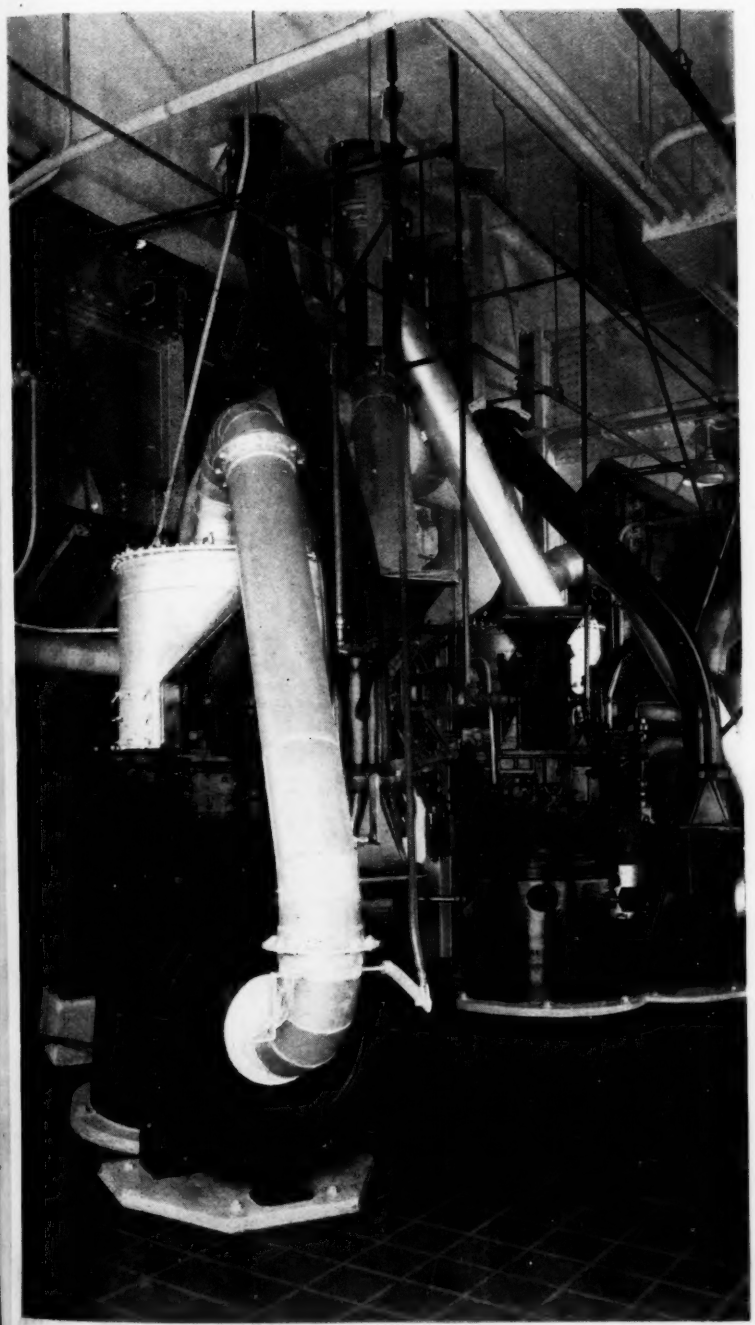
Power Plant ENGINEERING



• CONTENTS •

Engineers' Preview 7
Helpful Bulletins 41
New Equipment News 56
What Leaders Say 67
Champion-International Adds New Boiler. 68
By L. B. Rogers
How Russia Is Burning Peat for Power.. 73
Burning Coal in the Mine 74
By Chester R. Earle
How to Operate and Maintain Water Tube Cleaners 78
Electrostatic Precipitators .....
The Practical Engineer and Electrician.... 83
Weighing Coal in the Power Plant.....101
By Wilbur G. Hudson
Atomics 104
Problems in Atomic Power Development
By Andrew W. Kramer
How to Buy Coal.....108
Selecting and Installing Thermocouple Leadwires 110
By C. C. Roberts and C. A. Vogelsang
The Gas Turbine Power Plant—VI.....113
By John I. Yellott
Construction of Axial Air Gap Motor.....126
Diesel Engineering Instructors Take "Refresher Course" 130

• • • •

Coming Events....154; Obituaries....154; News from the Field....156; Manufacturers' News....160; Catalog Library....168; Construction News....186; Manufacturers' Personals....190.

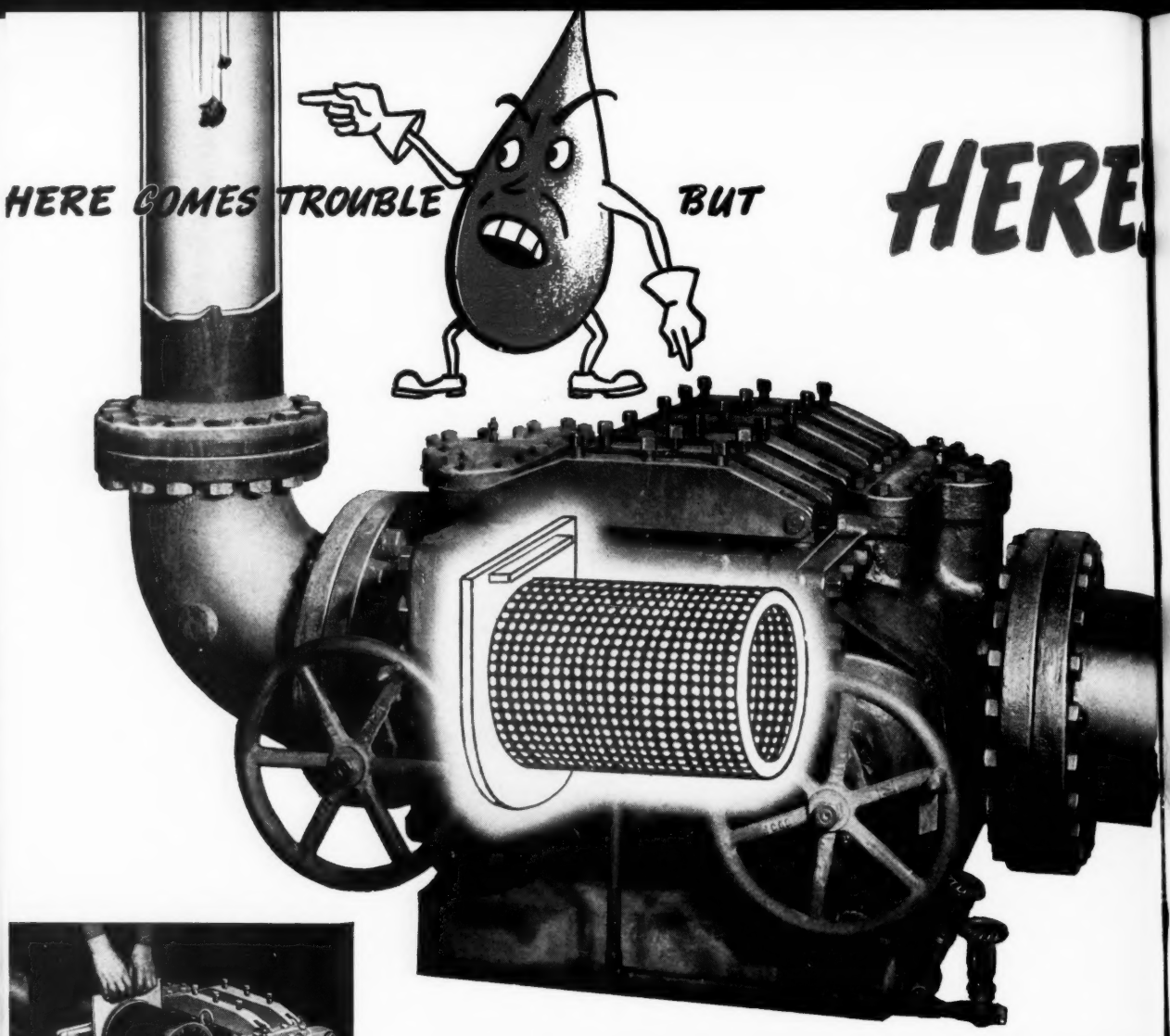
• • • •

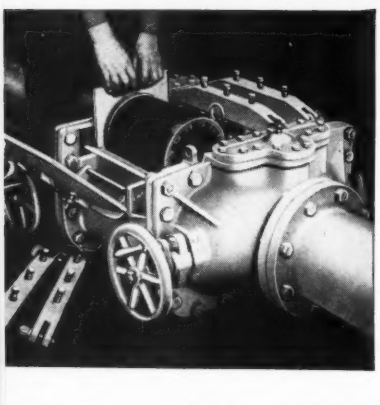
COVER: AUTOMATICALLY CONTROLLED COAL PULVERIZERS IN POWER HOUSE OF INDUSTRIAL RAYON CORPORATION AT PAINESVILLE, OHIO.

• • • •

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

SEPTEMBER, 1947





TWIN BASKETS MEAN NON-STOP SERVICE

When a basket needs cleaning, gate valves switch the flow to the twin basket. Backing off a few nuts releases the cover, and the fouled basket is removed, dumped, and replaced ready for its turn of duty again. In larger twin strainers the gate valves are motor operated.

NEW DEVELOPMENTS IN
ELLIOTT SELF-CLEANING STRAINERS

Used for removing foreign matter from water which has already been screened or strained. Motor-driven rotating element blanks off successive sections, which are cleared by back-flushing. Drive mechanism is powerful but small and compact, requiring low head-room. When necessary, straining units can be removed and replaced without removing the cage. This strainer in normal service requires no attention beyond general observation. Hundreds now in successful service, in sizes from 4" to 24".

Power Plant ENGINEERING

September, 1947

VOLUME 51—NUMBER 9

Engineers' Preview 7
Helpful Bulletins 41
New Equipment News 56
What Leaders Say 67
Champion-International Adds 70,000-lb-per-hr Boiler **68**
By L. B. Rogers
How Russia Is Burning Peat for Power 73
How Coal Is Burned in the Mine to Produce Power and Synthesis Gas 74
By Chester R. Earle
How to Operate and Maintain Water Tube Cleaners 78
Electrostatic Precipitators .....
The Practical Engineer and Electrician 83
Weighing Coal in the Power Plant 101
By Wilbur G. Hudson
Atomics 104
Problems in Atomic Power Development
By Andrew W. Kramer
How to Buy Coal 108
Selecting and Installing Thermocouple Leadwires 110
By C. C. Roberts and C. A. Vogelsang
The Gas Turbine Power Plant—VI 113
By John I. Yellott
Construction of Axial Air Gap Motor 126
Diesel Engineering Instructors Take "Refresher Course" 130
Coming Events 154
Obituaries 154
News from the Field 156
Manufacturers' News 160
Catalog Library 168
Construction News 186
Manufacturers' Personals 190

Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

Copyright, 1947, by Technical Publishing Company.

Entered as second class matter September 8, 1932 (original entry May 1, 1908), at the Post Office, Chicago, Illinois, under act of March 3, 1879.

EDITORIAL STAFF

RALPH E. TURNER
Editor

ANDREW W. KRAMER
Managing Editor

CHESTER R. EARLE
Associate Editor

THOMAS E. HANSON
News Editor

GEORGE V. TEAL
Associate Editor

Published Monthly by
TECHNICAL PUBLISHING CO.
53 W. JACKSON BLVD.
CHICAGO 4, ILL.

KINGSLEY L. RICE, *President*
EDWIN C. PROUTY, *Vice President*
WALTER PAINTER, *Vice President*
ARTHUR L. RICE, JR., *Treasurer*
CHARLES S. CLARKE, *Secretary*
JOHN O. AARVOLD, *Prod. Mgr.*

DISTRICT MANAGERS

CHICAGO: Charles S. Clarke
Arthur L. Rice, Jr.
53 W. Jackson Blvd., Chicago 4, Ill.
Harrison 0824

PHILADELPHIA, PA.
Charles A. Loney
437 Riverbank
Delanco, N. J.
Riverside 4-0380M

NEW YORK: Oscar Wilds
Graybar Bldg., New York 17, N. Y.
Caledonia 53779

CLEVELAND: A. H. Van Duyn
681 Union Commerce Bldg.
Cleveland 14, Ohio
Cherry 1377

PACIFIC COAST REPRESENTATIVES

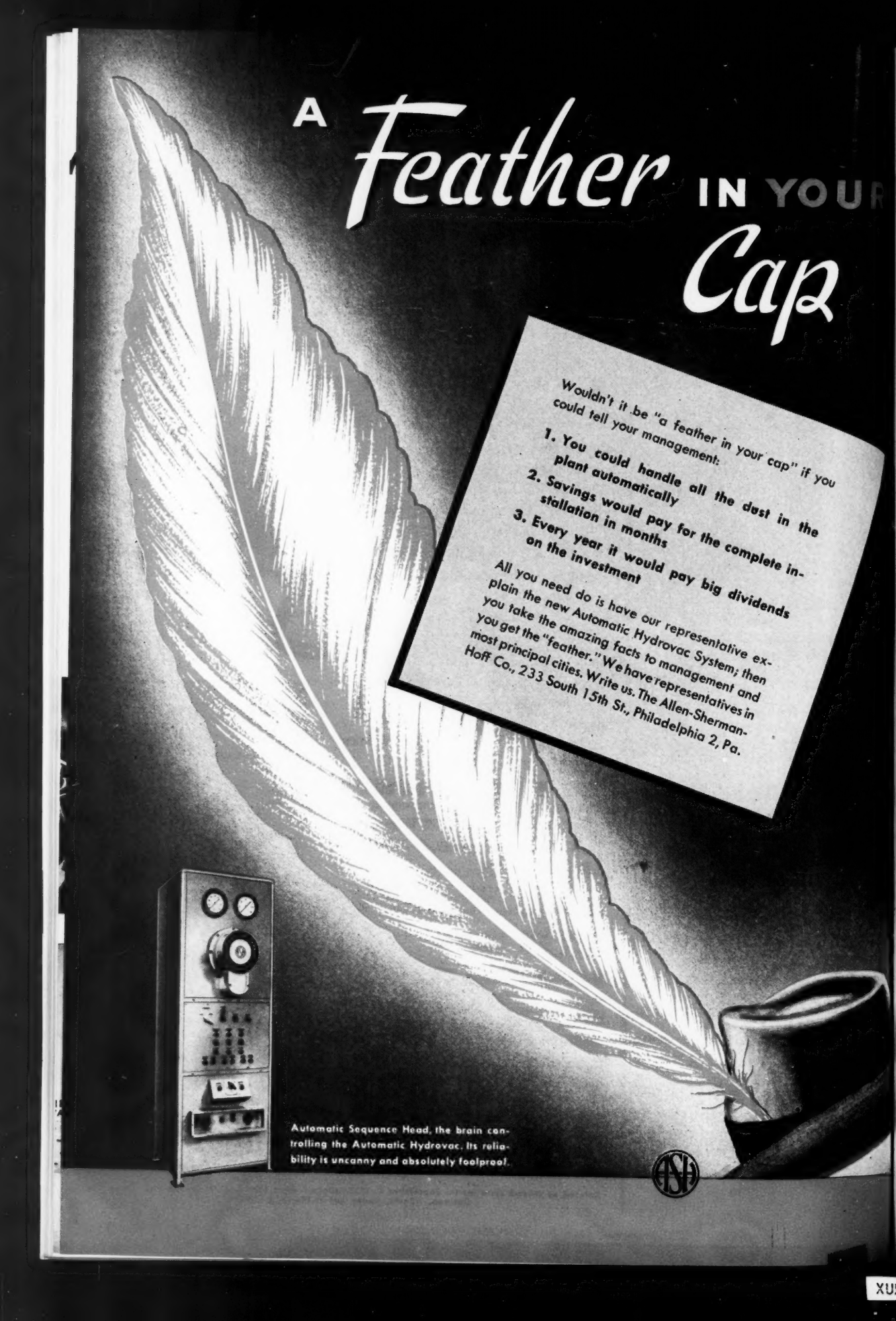
Roy M. McDonald & Co.
San Francisco: Roy M. McDonald, Mgr.
564 Market St.
San Francisco 4, Calif.
Garfield 8966

Los Angeles: Robert Aland, Mgr.
639 S. Wilton Place
Los Angeles 5, Calif.
Drexel 2590

Seattle: Thomas L. Emory, Mgr.
1411 Fourth Ave.
Seattle 1, Wash.
Elliott 1370

WASHINGTON OFFICE

Business Press News Bureau
1007 National Press Bldg.
Washington, D. C.


A Feather IN YOUR Cap
Wouldn't it be "a feather in your cap" if you could tell your management:
1. You could handle all the dust in the plant automatically
2. Savings would pay for the complete installation in months
3. Every year it would pay big dividends on the investment
All you need do is have our representative explain the new Automatic Hydrovac System; then you take the amazing facts to management and you get the "feather." We have representatives in most principal cities. Write us. The Allen-Sherman-Hoff Co., 233 South 15th St., Philadelphia 2, Pa.
Automatic Sequence Head, the brain controlling the Automatic Hydrovac. Its reliability is uncanny and absolutely foolproof.

ENGINEERS' PREVIEW

NEW LOW-PRESSURE large-diameter packless expansion joints range from 14 in to 6 ft in diameter, are applicable to all pipe sizes—expansion in the nature of tightly-folded bellows of stainless steel—all temperatures and pressures, normally supplied in stainless for pressures to 30 psi. Other metals may be specified. Also, new packless anchor-base elbow expansion joint, available in all pipe sizes and choice of materials to meet specific corrosive, temperature or pressure conditions.

★ ★ ★

NEW MARKING INK in red, black, white and blue requires no heat for fixing; is applicable to glass, procelain, rubber, photo films, laboratory materials. Red, black and white are used directly on glass. Blue is used where permanence is not desired or when surface is to be protected from abrasion, but with an undercoat of white becomes permanent; recommended for porcelain and ceramic materials—when fired it becomes permanent black, visible even at red heat. Ink is resistant to acids, alkalies, usual solvents, high temperatures. Before it dries it can be wiped off, in case of error.

★ ★ ★

TO REVEAL internal combustion engine compression leakage past valves, rings, gaskets, a compact portable tester is equipped with quick-connect air-supply fitting and 10 ft of hose ending in trigger-operated expansion fitting or rapid spark-plug hole attachment, and built-in valve to regulate pressure. Device is connected to 80 psi (no less) air supply cylinder fitting, inserted and expanded, regulating valve adjusted to bring pressure indicator to set-point. Adjacent leakage gage shows loss in psi (alternate cfm scale available). Also check unit comprising calibrated orifice or standard leak for testing gage accuracy when on cylinder.

★ ★ ★

FOR HEAT-TREATING materials highly reactive to gases, new high-vacuum furnace capable of continuous operation at 1800 C (3272 F) consists of three chambers integrated into one cubicle. Cycling circuits incorporated, so one chamber can be in treatment while another is being pumped and third reloaded. Very high vacuum can be attained. Heating is accomplished by large diameter tungsten elements at low voltage, minimizing ionization, permitting very rapid approach to full temperature. Each chamber equipped with special high-speed oil diffusion pump to maintain high vacuum during difficult outgassing operations. Interlocking safety devices provided; program timers control cycle. Unit consumes 15 kw power, has 175 cu in treating capacity.

★ ★ ★

LIX-SOL hard carbon solvent developed to remove high-temperature carbon deposits from aluminum alloy pistons, dissolves and disperses all petroleum residues, including lacquer, varnish, sludge, leaving metal clean, ready for reuse. Parts to be cleaned are submerged in warm solvent, agitated, flushed with warm water; it leaves a rust-protective film.

LIGHTWEIGHT metal bridge-ramp for use between warehouse or loading dock and railroad cars, has diamond safety non-skid surface, heavily trussed beneath for maximum loads, with perfect fitting edges for easy entry, high side guards prevent accident to operator, load or equipment. One man lifts and positions it. Crowned for differences in levels. Independent locking devices on each side with sufficient adjustment to secure it safely.

★ ★ ★

WEIGHING 1 ounce, measuring 9/16 by 7/8 by 1-13/16 in, a new non-spill rechargeable storage battery, 2A045, has a voltage of 2.2; capacity of 450 milliamp hr.

★ ★ ★

WAR AIRCRAFT to industrial chemicals! Aluminum parts salvaged from wrecked airplanes are cut into small pieces, then converted to anhydrous aluminum chloride, widely used chemical in strong continuous demand (10c a pound in drum lots) in a new Texan process.

★ ★ ★

NEW SCIENTIFIC instrument measures moisture in any substance, recording to the percentage in 15 seconds, has direct-reading electronic meter, is automatic in action, requires no calibration curves nor charts. Corrections for temperature of material being tested are compensated automatically.

★ ★ ★

USABLE alone or with other materials as reinforcement for sheet, laminated or shaped plastics, Modigliani glass veil has special advantages, adding strength, texture and color without weight, thickness or bulk. This, only unwoven glass fabric available in superthin construction (2.5 mils), is a refinement of flexible glass fabric, with apparent one-direction stretch achieving multi-direction ability when of sufficient width.

★ ★ ★

WAR-DEVELOPED Vacu-Therm generator produces quickly developed heat to 550 deg. (plus or minus 5 deg.) under low operating pressure, is insulated, self contained, has no moving parts, motors, pumps nor gaskets. Dowtherm E liquid, sealed in heavily-welded vacuum chamber, vaporizes when reaching its efficient operating range and transfers heat through flexible pipes. Normal operating temperature to 400 deg. requires only 15 psi, eliminating danger and maintenance of high-pressure equipment, is controlled by pressurstats. Three sizes, 16, 22, 33 kw capacity.

★ ★ ★

PHOTO-ELECTRIC actuator No. 600 has light beam 1/16 in. wide, will respond to light changes as small as 20 per cent, does not require complete interruption, so 0.001-in. objects have been counted with absolute accuracy. Contains also capacitor discharge output circuit for high-speed operation of control solenoids, in packaging equipment, deflector gates, etc.

FLEX-TEE COUPLING connects laterals to existing pipe without need for threading, does away with normal nipples, tees, unions, couplings. Available in 2-in. size for cast-iron standard and O D pipe, other sizes down to ¾-in. Each is same nominal size as pipe run, but standard threads for bushings.

★ ★ ★

ATTENTION-arresting Blink-O-Lite panel warning lamp blinks automatically when activated. Easily mounted in a single hole; only one terminal is required in grounded panel. Contains all flashing mechanism; uses standard bulbs, is readily accessible from panel front. In a variety of sizes and voltages.

★ ★ ★

VANGUARD new commercial fluorescent unit of modified V-design with eggcrate louvers is recommended for plants, shops, offices, stores, showrooms, etc. Frosted ribbed glass side panels are top-hinged for easy maintenance, slotted-in sections eliminate dark ends. Canopy or stem optional. Units may be mounted in continuous runs without moving ends or using special parts.

★ ★ ★

LIGHTWEIGHT LADDER collapses smaller than a 2 by 4 timber, the side rails of extruded aluminum fold together and the hinged rungs or aluminum tubing fit within extruded sections. Weight is 40 per cent less than conventional wood ladders of same length. Simple snap-action locks ladder firmly and safely in open or closed position. All standard lengths to 28 ft, single or extension types.

★ ★ ★

ELECTRIC HAND tool using standard attachments, can apply or remove nuts, drive or remove screws, drive wood augers, drill, ream, tap, run wire brushes; with impact mechanism can drill masonry or bricks. Has special hammer and spring mechanism which permits four interlocking lugs to disengage and rotate half a turn before reengaging when a predetermined torque has developed; results in a series of sharp impacts adding to the turning forces. Also acts as a safety device to prevent overloading. Impact mechanism does not come into play up to the predetermined torque but if the spindle slows and the motor heats, mechanism will act as a release.

★ ★ ★

ONE-MAN electric chain saw weighing 27 lb may be used for felling, limbing or bucking trees or cutting any timber to 29 in. in diameter, making cuts at any angle. Electric power is furnished by a small gasoline-driven generator available in two sizes to operate one, or two saws. Motor is 2½ hp, generates 80 cycle three phase current with grounded connection. Handle can be attached to far end of saw for two man handling.

★ ★ ★

NEW; LIGHT, compact soldering outfit, operating on the resistance-heating principle, heats faster, has a thumb switch for close heat control, looks like a small box with handle and cables the soldering end of which is a pliers. The closing of this completes the secondary transformer circuit and heats the work on this exact spot for quicker results. Radiating fins isolate the Meehanite jaws from the plastic handles. Pliers can be locked in any position with a tightening screw. Intended for small work capable of being held in the jaws, as solder lugs, sweating pipe and wire joints, etc.

INTERESTING to all working with heat are the new Curie Point alloys (iron in such proportions as to obtain the required Point) permit apparatus or processes dependent on temperature for the proper operation to be controlled as desired between 180 and 1000 deg F. Below the Curie Point, the alloys are ferromagnetic with high permeability; above it they are paramagnetic and have very low permeability. The transformation temperature, wholly reversible is fixed by the alloy's composition and is unaffected by any other factors. Usable in magnetic circuits as in a relay armature. Below the Point it will be attracted by the relay's magnetic field but if heated above the Point it will no longer be attracted. Transformation occurs in either direction at the same temperature in any given alloy.

★ ★ ★

RECOMMENDED for concrete ahead of steel tank installations, Hydrocide mastic fibrated asphalt composition of plastic consistency, free of coal tar compound dries in 48 hours, prevents tank corrosion. Applied as a continuous film, produces a heavy elastic membrane-like coating to act as a moisture barrier.

★ ★ ★

PIPE AND SEWER cleaning operations, greater speed and economy for operator's safety, portability, reversible electric operation are claimed for Flexicleaner built for industrial firms, power plants, plumbing contractors, municipalities, etc. It is a small electric motor and V-belt driven speed changer on two rubber-tired wheels, designed to handle flexible steel as well as coiled cleaning rods.

★ ★ ★

DANCO NYLON-COVERED cable in two sizes, 6/32 and 7/32 in. o d, now used in industrial and transportation fields, has withstood 320,000 flexings before the steel core broke and 410,000 before the nylon covering severed. Cable gives exceptional fatigue and abrasion resistance; will not fray, rust nor rot; resists moisture, salt water, fire; has attractive silk-smooth surface adaptable to home and office uses.

★ ★ ★

PORTABLE gas-driven d-c arc welder weighs 315 lb, mounted on two wheel dolly with pneumatic tires, 32 in. long, 26 wide, 28 high (without wheels), stationary model with guard frame, fits into jeep, station wagon, car trunk compartment, smallest trucks. Aluminum housing, other light parts, two-cylinder opposed engine direct-connected to four-pole self-excited generator with interpoles. Welder rated at 150 amps at 30 v on 50 per cent duty cycle. Uses electrodes to 5/32 in. plus certain types of 3/16. Outfit has two receptacles for extension cords to be used for emergency lighting.

★ ★ ★

MERCURY COMPRESSOR clutch incorporates a time delay that retards its engagement a second or more, long enough to allow the motor to reach full speed before the load is applied, thus exerting its greatest torque and rotor inertia when most needed. Motor current is reduced, starting windings protected, pressure relief valves eliminated. Centrifugal force acting on a small amount of mercury produces hydraulic pressure dependent on the head not the quantity. This pressure is utilized without levers or other mechanical means to cause the friction clutch engagement.

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILERS

1 **Steam Generators** — Automatic steam generators for industrial use are covered in Bulletin No. 12A. The advantages of automatic boilers are briefly described. Parts of the boilers, such as readily accessible heating surfaces and rotating soot blowers, are pictured and described in detail. Other outstanding features are also covered. One page, accompanied by a line diagram, describes the operation of these automatic steam generators. Another page presents a cutaway wash drawing with a table of condensed specifications. Besler Corp.

2 **Stirling Boilers** — This bulletin describes the company's Type H Stirling boiler which is a relatively small, water tube unit designed primarily for installation where headroom is limited. It is said to be particularly suitable for installation in industrial power plants, for process steam requirements, for smaller central stations and for heating purposes. Several specific installations of the boiler are cited and dimensional data are given for the various sizes and capacities of the unit. The Babcock & Wilcox Co.

3 **Steel Boilers**—Catalog 97 describes a line of steel boilers designed for oil, gas, stoker or hand-fired coal firing; sizes range from 2680 to 42,500 sq ft steam radiation. Complete specifications on the units are listed in tabular form and illustrations and text describe the boilers' characteristics. Installation photographs are presented. Kewanee Boiler Corp.

PRIME MOVERS

4 **Mechanical Drive Turbines**—Bulletin H-16 describes this company's type YR mechanical drive turbines. This bulletin gives directions on selection of unit and presents tabular material of general specifications and material specifications. A large sectional drawing of the unit is used as a vehicle for pointing out 21 of the unit's constructional features. Another similar section presents modifications to standard turbines. Types of governors are pictured in the bulletin. Also presented is a table of approximate dimensions for each frame and this table is accompanied by a dimensioned line drawing. Elliott Co.

5 **Steam Engines**—Vertical type steam engines are shown in Bulletin No. 306. The application of the modern steam engine to industrial plants is briefly covered in the first part of the booklet and illustrations, both photographic and sectional line drawings, are presented. A full page table of engineering material is given for the types E and ST vertical engines. Construction details of such parts as the piston and rod, cross-head, crank shaft, flywheel and governor, etc., comprise the remainder of the booklet. Troy Engine & Machine Co.

ELECTRICAL

6 **Wiring Labels**—This is a 4-page bulletin which presents information on the "Quik-Label" code cards which carry gummed labels for use in identifying wiring. The first page of the bulletin shows the cards and lists the exclusive features. The second page shows how these code cards are made up to meet specifications and the third page presents a price and stock list. The price and stock list information is continued on the fourth page and presented in tabular form. This shows the various symbols—letters, numbers and even star and delta diagram cards which are available. W. H. Brady Co.

7 **Electrical and Automotive** — Form GU-86 is a 16-page booklet describing briefly the company's line of electrical and automotive products. A single page is devoted to the description of such classes of products as single-phase and d-c motors, polyphase squirrel-cage motors, power transformers, distribution transformers, etc., and to industrial brakes, industrial brake products and to such automotive products as brake lining, brake replacement parts, tools and equipment. Wagner Electric Corp.

8 **Rewinding Motors**—This new silicone data sheet titled, "Specifications for Rewinding Motors with Silicone Insulation" is specified as Note No. B-30-1. The data sheet gives information on materials and workmanship and requirements for such items as magnet wire, coil separators, phase separators, etc. Dow Corning Corp.

9 **Permanent Magnets**—This is the title of a recently issued 36-page handbook on Permanent Magnets, their characteristics and applications. The headings of the departments indicate the scope of the bulletin. Among these are "Permanent Magnet Characteristics," "Permanent Magnet Design," "Properties of Permanent Magnet Materials," "Permanent Magnet Applications," and ordering directions. Characteristics, curves, drawings of circuit arrangements, operations of various magnet arrangements, photographs of manufacturing processes and many other illustrations make the book exceptionally clear. Metallurgy Division, Chemical Department, General Electric Co. (Pittsfield).

10 **Cable Design**—Bulletin OK-2009E is a 16-page bulletin describing the company's wires and cables in which no tapes or braids are required over the insulation. Advantages of this cable are described in the first part of the booklet and the following tabular material presents information on visual corona. Surface resistance and other characteristics are tabulated in other parts of the bulletin. Sectional drawings show the effect of charging current drainage in cable hanging in a vertical conduit. Other photographs show installations. The Okonite Co.

CONTROLS, REGULATORS

11 **Combustion Control**—This electronic combustion control, described as capable as reducing smoke and increasing boiler efficiency, is pictured and described in this 6-page folder. Operating construction features of the unit are completely outlined, specifications are given and descriptions of the physical features of the unit are told. Furst Electronics.

12 **Feed Water Regulation**—Bulletin 429B is a 12-page bulletin which covers the company's automatic flow regulator for controlling boiler feedwater. The bulletin not only presents information on the operation and construction of the unit but also presents photos of installations, charts and studies of boiler water level control under various conditions of pressure. Colored drawings are used to more effectively portray the operation of the unit. Specifications are listed. Northern Equipment Co.

13 **Regulator Interchangeability**—Bulletin 468 is a new 4-page bulletin which discusses the four important phases of interchangeability as applied to this company's line of regulators. The booklet lists, in tabular form, key internal working parts of regulators which are renewable and interchangeable in various sizes of these regulators which serve different functions. It is pointed out that with this table as a guide a smaller quantity of parts can be stocked. Leslie Co.

14 **Instrument Panels** — Eight pages of information on instrument panels and cubicles are presented in this recently issued bulletin. Information on how to order standard control boards and panels is presented on the second page of the bulletin and a full page blueprint type illustration shows standard panel units and accessories which are available. Two full pages of illustrations show how these panels may be knocked down and also show the various types of units which are available. Information and photographs telling about the company's standard cubicles also are given. Falstrom Co.

15 **Electronic Instruments**—Bulletin 231 describes this company's recently developed line of electronic instruments for temperature, pressure, flow and other factors. Eighteen outstanding features of the unit are given in the front part of the booklet and photographs of various types of the units accompanied by brief descriptions of each are presented in the following few pages. Measuring circuits are described and diagrams of the circuits are presented. These include resistance bridge, impedance bridge, potentiometer circuits and calculating circuits. A description and diagrams of the resistance thermometer are given. Bailey Meter Co.

16 **Remote FW Control** — Bulletin 471 describes this company's Type P regulator for remote boiler feedwater control. The bulletin tells first why this type of regulator was developed and then describes construction features of the unit. Complete hookups of the regulator with different types of valves are shown. Complete descriptions of such hookups are given in the accompanying copy. Northern Equipment Co.

17 **Air Control**—Industrial products for efficient air control are described in this recently issued 8-page folder. Typical of the products shown in the bulletin are air ejection sets, pneumatic power press controls, air cylinders, air pressure regulators, pilot valves, etc. Each of the products is briefly described and diagrams and wash drawings illustrate not only the products but its application and use on allied equipment. Tables of catalog numbers for various types of equipment are given and in some cases sizes and pressures are tabulated. A. Schrader's Son, Division of Scovill Manufacturing Co., Inc.

VALVES

18 **Stainless Steel Valves** — Valves and fittings in the company's line of stainless steel products are described in Catalog No. 47, 56 pages. The various alloys of which the valves are made are first described and the conditions for which each alloy was designed are pointed out. Complete descriptions of all the valves and fittings in the line are accompanied by cross-sectional and full views and tables of dimensions. An exceptionally useful section of the book is the one on application data which shows the various corrosive mediums to which the material may be subjected and then recommendations are listed. Alloy Steel Products Co., Inc.

SEPTEMBER, 1947

POWER PLANT ENGINEERING

53 W. Jackson Blvd.
Chicago 4, Illinois

Please have the manufacturers send me without obligation the literature indicated by the following paragraph number:

.....
.....
.....

Please Print Clearly

Your Name.....

Your Title.....

Your Company Name.....

Company Address.....

City.....**State**.....

(If you prefer delivery at your home also fill in below)

Home Address.....

City.....**State**.....

DEPARTMENT OF TECHNOLOGY
BUFFALO PUBLIC LIBRARY

XUM

19 **Butterfly Valves** — Bulletin 77 describes the company's line of butterfly valves designed especially for diaphragm motor valve operation. Characteristics and construction features of the valves are described and a chart shows flow characteristics taken from actual tests. Sectional and detailed drawings of the valves are used to list the various parts. Tables of capacities and dimensions are given in the back of the booklet. Fisher Governor Co.

20 **Self-Cleaning Strainers**—Bulletin 465 is an informative 8-page illustrated booklet recently issued. Presented in the bulletin are tables showing screen specifications and total free hole areas; these tables facilitate the selection of the correct screen for different services. Illustrations show several typical strainer illustrations for the protection of various pieces of equipment. Tables show dimensions of cast iron, cast bronze, cast steel and stainless steel strainers. A large chart, plotting saturated and superheated steam flows show pressure drops through the strainers. Leslie Co.

21 **Air Release Valve** — Operation, construction, and essential requirements of air release valves are described in a new bulletin. The booklet, Bulletin No. 140, discusses dangers of air in pipe lines and the safe solution to the problem—well designed, large capacity air release valves, which operate continuously and without attention. The Simplex Valve & Meter Co.

22 **Control Valves**—Catalog 546 covers a line of control valves for air, gas, oil, steam or water for pressures up to 500 lb. Applications of the valves—for use in place of a globe or gate valve where a quick-acting lever-operated valve is desired and for operating double-acting cylinders on various types of equipment—are described. Excellent line drawings, detailed engineering information, material classifications, tabulated price lists and dimensions, cover all the models. W. H. Nicholson & Co.

FUEL, BURNERS

23 **Industrial Oil Burner**—This company's recently announced rotary fuel oil burner which is designed for firing Number 6 or lighter oil, is described in Form 1160B. The bulletin, besides presenting illustrations of the unit, lists specifications and presents a table of load capacities in e.d.r. steam and hot water. Other information includes a table of available control arrangements. Information on the various models in the line with their capacities are listed on the back page of the folder and dimensions of the units also are given. This last table is accompanied by a dimension diagram. Iron Fireman Manufacturing Co.

24 **Coal Reference Bulletin**—"600 Post-war Installations" of power plants throughout the United States are covered in this latest Bulletin No. 10. The trend in new central stations and industrial plants is sketched and outstanding features of design of many of the best stations are briefly described. Sectional views of the boilers are presented. A table presents an industry classification of power plants by types of firing. Fairmont Coal Bureau.

LUBRICANTS

25 **Oil Test Set**—This is a 4-page mimeographed bulletin which describes this company's recently developed oil test set for determining Saybolt viscosity, flash point and gravity. The oil test set is pictured and a brief description of all the component parts and method of operation of the set follows. Roberts-Konrad, Inc.

26 **Lubricants Research**—Here is a 24-page booklet which describes the story of the company's research program for developing improved industrial lubricants. The booklet is titled, "Better Lubricants for Industry Through Research" and it presents a panorama of lubricant development ranging from modern techniques of oil discovery through refining, analysis testing, and the creation of future products. Among the 48 photographs are shown pilot plants, endurance testing machines, micro-laboratory equipment and electron microscopes. Gulf Oil Corp.

27 **Pocket-Size Recommendation Chart** —This 3-fold folder is a condensed guide to the proper usage and application of this company's greases and lubricants. The folder is arranged so that the equipment to be lubricated appears in the left-hand column and beneath these listings appear the parts to be lubricated; directly opposite the parts are listed the type or types of lubricants to be used. Characteristics of the lubricants are given on the back spread of the folder. Adam Cook's Sons, Inc.

28 **Centralized Lubrication**—Bulletin No. 25, 16-pages, gives complete information on this manufacturer's centralized system of lubrication. A complete description of the system is provided in the first few pages and then the bulletin goes on to describe and picture details of the system's construction and operation. Twelve reasons why the system of lubrication helps maintain production are described in another section of the booklet. Fittings and accessories are illustrated and line drawings accompanied by sizing tables aid in planning and ordering. The remainder of the booklet presents photographs of typical installations. The Farval Corp.

POWER TRANSMISSION

29 **Fluid Drives**—Adjustable speed fluid drives for 3600 rpm boiler feed pumps are described in this four-page Bulletin 8019. An excellent cut-away illustration of the drive is presented and a curve indicates the improvement in feed pump operation as shown in an installation in a large power plant. Operational and construction features of the unit are pointed out. American Blower Corp.

30 **V-Belt Drives**—This 12-page bulletin, Form A469-3471, describes a complete line of V-belt drives. A brief description of each of the various types is presented on the first page and the booklet then presents complete information on the belting on other pages. The bulletin is well illustrated and the advantages of the belts' construction are covered. Operation under various conditions and on various types of drives are explained. Dayton Rubber Co.

GASKETS, PACKING

31 **Metal Packings**—This excellently done 4-page bulletin is filled with information on the company's line of metal packing for industrial uses. Clear, understandable line drawings accompany the descriptions of the various types of packing. Packing rings, wiper rings and piston rings also are described and illustrated. France Packing Co.

32 **Gasket and Sealing Materials**—This 20-page bulletin contains suggestions for the selection and use of resilient sealing materials, a chart of gasket recommendations for sealing various liquids and gases and a number of diagrams showing physical properties of different gasketing compounds. Actual application of the materials are shown in line diagrams underneath which is given a brief description of the use and reason for the use of the particular material in this particular spot. Useful sections include "Factors in Choosing Resilient Gaskets," "Designing Gaskets to Reduce Cost," and "Sealing with Confined Resilient Gaskets." The bulletin is exceptionally well illustrated. Armstrong Cork Co.

33 **Centrifugal Pumps**—Bulletin 4010-A, 16 pages, tells of this company's line of single stage, side suction centrifugal pumps. Complete engineering and construction details of the unit are given and performance tables for various units in the line, both motor and belt driven, are presented. Dimensions of the pumps are given in another section. General engineering data include conversion factors, suction lift of pumps at sea level and higher altitudes, suction head requirements when pumping hot water and tables of pipe friction. The Deming Co.

34 **Materials Handling Pump** — Catalog 547 titled, "Hydroseal Pump," is a 16-page bulletin which describes all the late developments and improvements in this unit. Sectional drawings show the sand pump which handles materials larger than slurries; the Hydroseal dredge pump which handles large and heavy materials up to 6 inches and the Hydroseal slurry pump which handles very finely divided materials. Excellent line drawings and colored illustrations picture the latest developments in the pumps' construction. Tables based on clear water performance occupy pages 8 and 9. "Calculating the Pump Required" is a highly useful section. Miscellaneous engineering data consists of tables of specific gravity and water friction in pipes. The Allen-Sherman-Hoff Co.

35 **Centrifugal Pumps**—Bulletin 4012-A is a 16-page catalog which covers the company's line of single stage, side suction, centrifugal pumps. Wash drawings of various units in the line are presented and these are accompanied by descriptions of some of the outstanding features of the unit and a brief overall description. In some cases information is tabulated and the back part of the folder presents several pages of tabulated performance data on the motor-driven and belt-driven units. Still more tabular information includes dimensions of both belt and motor driven units. Another product described is sump pumps. Engineering data include tables of comparisons of pressures and other conversion factors; suction head requirements when pumping hot water; rules to determine size and speed of pulleys and tables of pipe friction. The Deming Co.

36 **Pedestal Type Pumps**—The company's pedestal type centrifugal pumps, the "Pedrifugal" unit, are described in this bulletin. Listed in tabular form are heads and capacities; also given is a Pump, Motor, Drive Table. Operating advantages are listed and illustrated and features of construction are outlined. Dimensional drawings and tables are given. Allis-Chalmers Mfg. Co.

MAINTENANCE

37 **Building Maintenance Guide**—"Over the Rough Spots," is the title of a recently-issued handbook on building maintenance. This book provides the answers to more than a hundred problems inherent in the maintenance and construction of all types of industrial buildings. Its 48 pages are packed with information about floors, walls, foundations, tools, etc. The booklet also contains information of special interest to railroads, mines, utilities and water works. Stonhard Co.

38 **Vapor-Cleaning Unit** — This latest equipment for steam-detergent cleaning is described in Form 6327R, 12 pages. Features of simple operation, control and delivery are outlined by means of pictures and text and the "completely automatic, safe operation," is described. Engineering specifications and operating data are given in great detail. Oakite Products, Inc.

39 **Floor Finish**—This 4-page bulletin covers "Stoncleum" which is described as follows: "Feels like rubber, wears like stone." Many photographs of rooms in which the product has been used are presented. Among these are storage warehouses, foundries, processing plants, etc. Descriptions of the advantages of the material and its physical features are presented and the bulletin points out how easy it is to use the material in corrective maintenance over all types of floors. Methods of application are shown photographically. Continental Asbestos & Refining Corp.

40 **Floor Levelers**—This product, "Levelite," developed for severest service in the leveling of floors, is described in this 4-page bulletin. All of its advantages, such as ruggedness, resilience, light weight, etc., are considered separately in the middle spread of the folder. The last page of the folder gives complete directions for application of the material and presents interesting line drawings which show some of the troubles which can be overcome by the use of the material and also pictures right and wrong methods of installation. Selby, Battersby & Co.

41 **Concrete Masonry Waterproofing** — A major problem in industry is the waterproofing of concrete masonry, especially where the masonry is under hydrostatic pressure as it so often is in power plants. This 16-page bulletin tells what this company's product is, how it works, and shows methods of applying. Photostatic evidence shows how the product enables concrete masonry to withstand hydrostatic pressure tests of 500 psi. Object of the tests is described and procedure, observations and conclusions are given. Some examples of the use of the product, Aquella, in concrete masonry construction are shown in photographs. Prima Products, Inc.

42 **Chemical Cleaning**—Chemical cleaning of heat transfer equipment or for removing mill scale, rust, corrosion and other deposits on metal is described in this new bulletin. Brief directions on the use of the chemical are presented in a step-by-step manner. General pickling operations are described in a separate box on page 3 and similar treatment is given to directions for cleaning heat transfer equipment and for stripping zinc plate. The

(Continued on page 166)

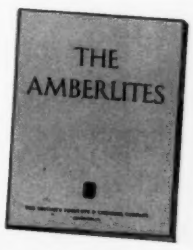
Amberlite deionized water stops corrosion and scale in Diesel-train heaters

Water impinges on the surface of the flash boiler in a Diesel train . . . turns instantly into steam . . . leaves no deposit to clog and corrode steam lines. It's AMBERLITE deionized water!

Industry after industry has turned to AMBERLITE Ion Exchange Resins to produce deionized water comparable in quality to single distilled; to soften boiler feed water; to reduce alkalinity and total dissolved solids; and regulate make-up quality with a minimum of equipment, space and maintenance.

You'll find, too, that in many chemical processes you can eliminate costly steps and improve quality with the AMBERLITES. Our staff will be glad to discuss potential applications of AMBERLITE IR-100 (cation exchanger) and AMBERLITE IR-4B (acid adsorbent).

Time-Tested Uses and New Ideas Worth Investigating



Our booklet "THE AMBERLITES" *suggests many applications for these time-tested Ion Exchange Resins—some applications already commercially established, others pointing the way to new fields of investigation. For your copy of this booklet, address The Resinous Products & Chemical Company, Department PPE-1 Washington Square, Philadelphia 5, Pa.*

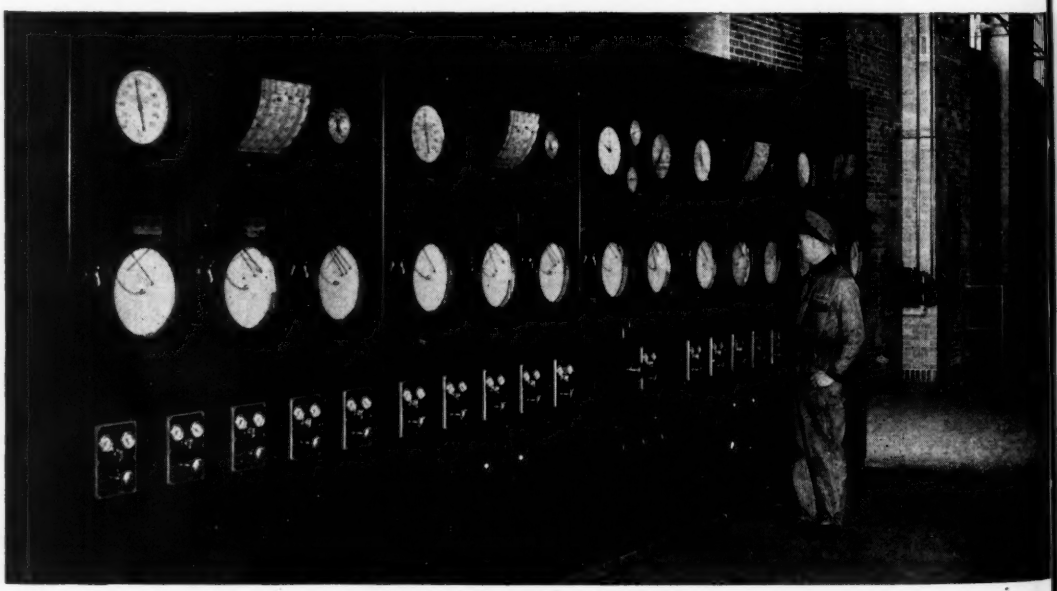
AMBERLITE *is a trade-mark, Reg. U.S. Pat. Off.*

THE RESINOUS PRODUCTS & CHEMICAL COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

HOW DOES YOUR BOILER PLANT RATE ON *THESE* POINTS?

1. Continuity of service.
2. Evaporation ratio.
3. Safety of operation.
4. Peak steaming capacity.
5. Utilization of available manpower.



This Bailey Boiler Control Panel continuously maintains Optimum Performance in a central heating plant.

BAILEY METER CONTROL

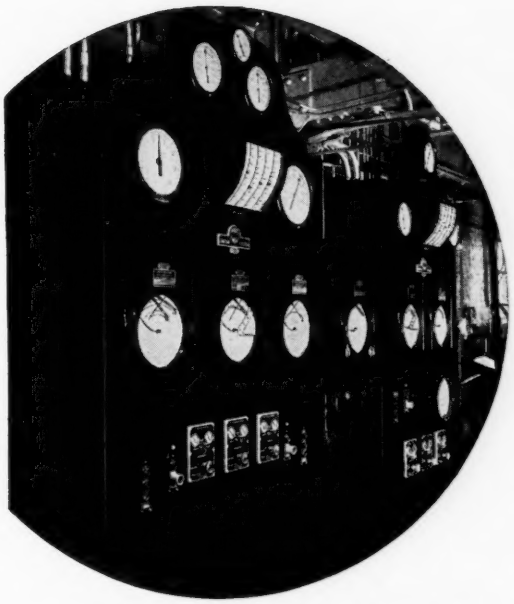
BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTR

★ Optimum performance may be secured on all these counts by applying engineered instrumentation in the form of Bailey Boiler Meters and Control.

Bailey Boiler Meters and Control are specified and applied to the individual requirements of each plant. Bailey engineering service starts with the selection of equipment and continues through the design, construction, calibration, installation, and final adjustment on the job.

Engineering work in the user's plant is done by Bailey Field Engineers, who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over thirty industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey Engineer in your community has a background of combustion engineering "know-how" which has been accumulated through years of service. He has at his command the results of thousands of tests on boiler installations covering a wide range of fuels, furnaces, and fuel burning equipment. He has more to offer than meters and controllers. He is primarily interested in helping you to secure optimum operating conditions in your plant. G-24



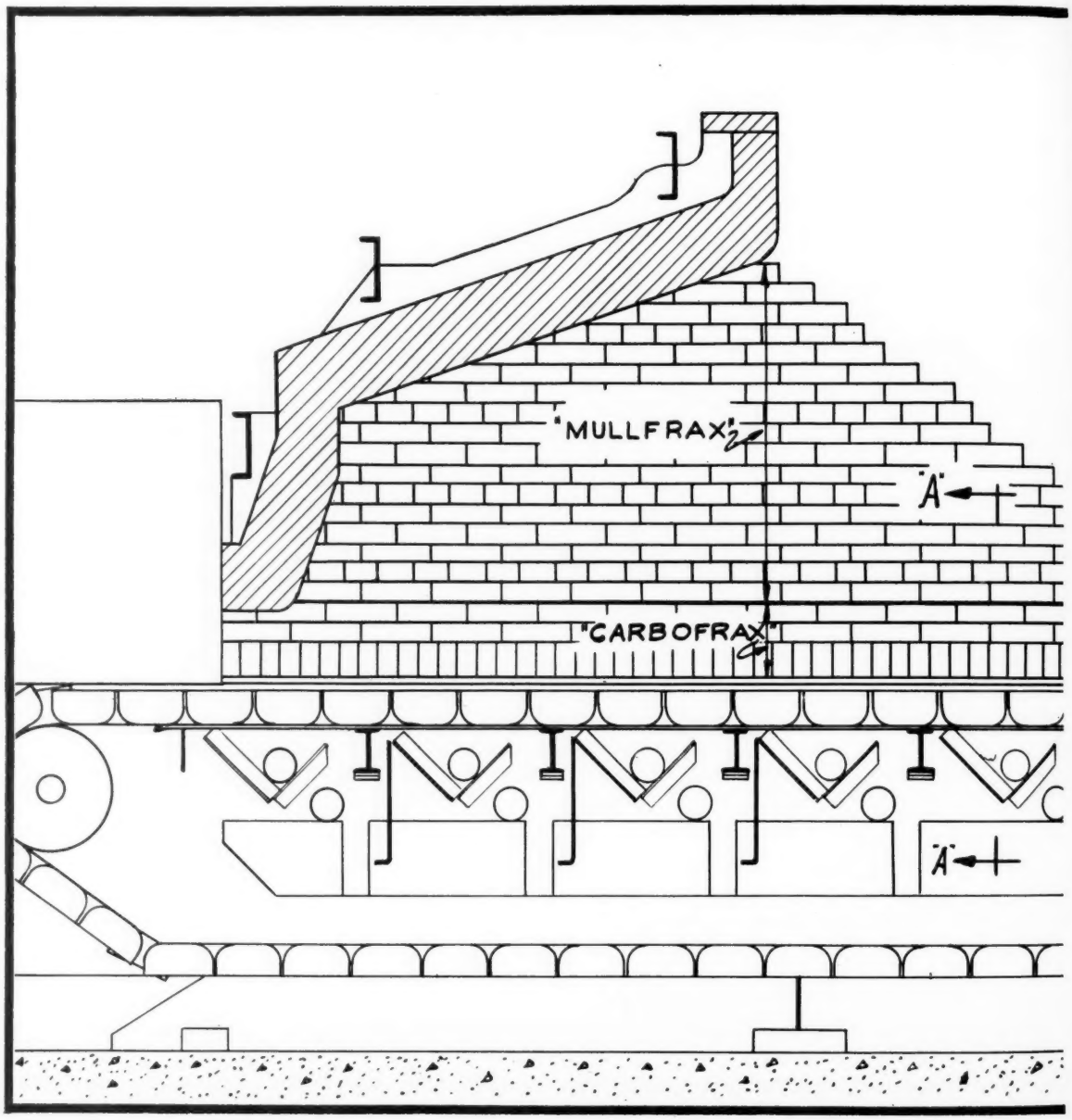
Installation of Bailey Boiler Meters and Boiler Control in an Eastern paper mill. This equipment automatically functions to maintain daily boiler performance at the same high standards obtained during boiler tests.

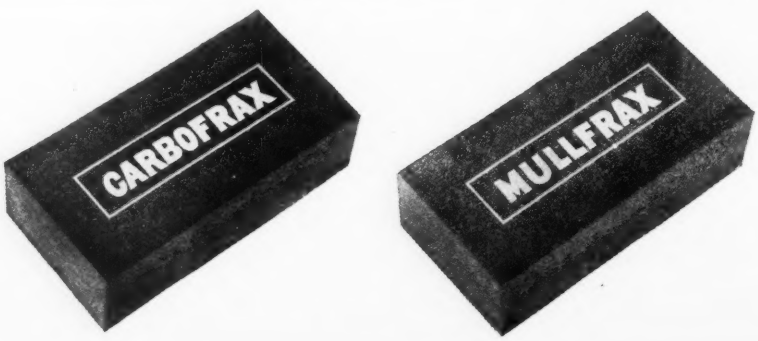
BAILEY METER COMPANY
1040 IVANHOE ROAD, CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

...The Complete Combustion Control System

...CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

A Super Refractories Combination

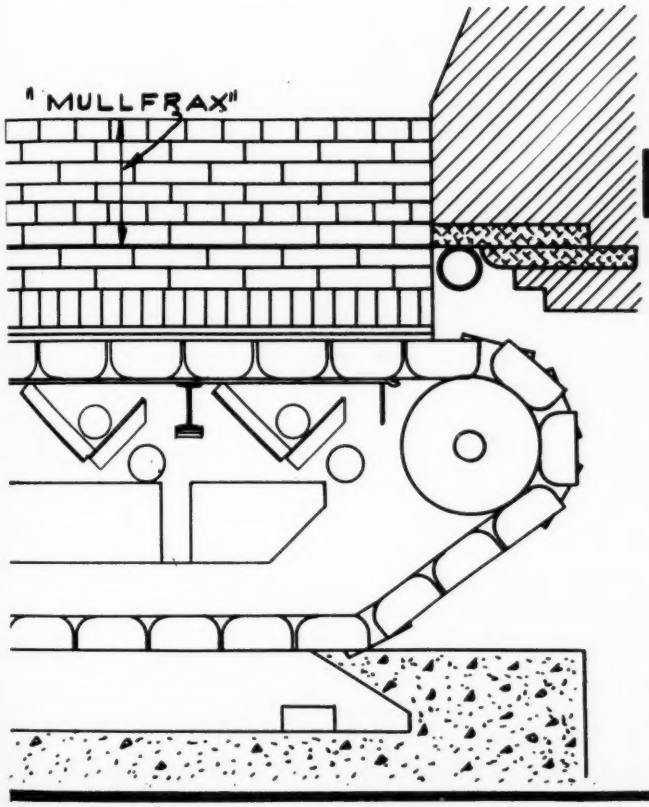




SUPER

that stands up to Low Fusion Ash Coals

Destructive slags from high pyritic sulphur coals are combatted successfully by using super refractories by CARBORUNDUM. Shown by the drawing is a typical application. Operating conditions, of course, determine actual heights of linings for specific installations.



CARBOFRAX silicon carbide brick are installed in the fuel bed zone where there is little likelihood of molten slag attack. They offer no anchorage for choking clinker accumulations. Their hard dense faces are kept clean by the moving fuel bed. Full grate area is available. Operation is more efficient. Greater steaming capacity is provided. Maintenance costs are cut. Because of high resistance to elevated temperatures, mechanical abrasion, spalling and flame erosion, CARBOFRAX brick last longer. Frequent repairs are eliminated.

MULLFRAX electric furnace mullite brick are installed above the CARBOFRAX brick belt in those sections where most severe conditions exist. They solve a dual problem. Remaining hard at high temperatures, these brick are impenetrable to any clinker formations resulting from variations in fuel bed depth. Accumulations are barred off easily, quickly without harming the brickwork. Resistant to fluid ash, chemically inert MULLFRAX brick retard erosion. Moreover, freedom from cracking and spalling helps insure superior performance-assists in promoting more continuous service.

This combination of super refractories by CARBORUNDUM steps up steam production . . . slashes maintenance expense in furnaces burning high sulphur, low fusion ash coals. Individually and in combination, they produce similar results in other applications. Use them on your next repair job. Investigate them for other jobs. Write Dept. H-97 for facts. The Carborundum Company, Refractories Division, Perth Amboy, N. J.

REFRACTORIES

BY CARBORUNDUM

TRADE MARK

"Carborundum," "Carbofrax" and "Mullfrax" are registered trademarks which indicate manufacture by The Carborundum Company.

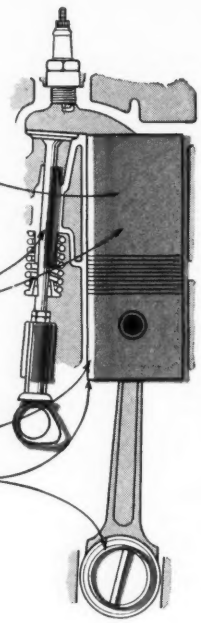
STANDARD ENGINEERS NOTEBOOK

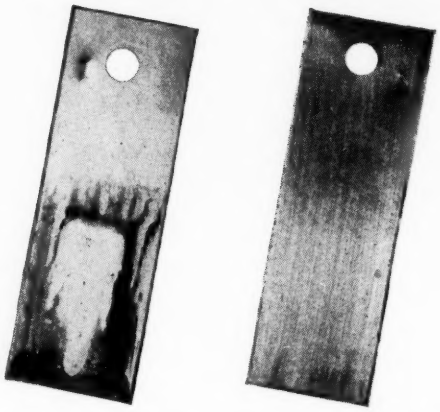
① Adhering agent in RPM Compounded Motor Oil keeps oil film on all parts after engine stops, even on cylinder walls.

② Rustproofing compounds prevent moisture that condenses on cooling parts from contacting metal.

③ No rust is formed to scrape off when engine starts, and cause excessive wear.

④ Constant lubricant film provides adequate and instant lubrication when engine starts.





This actual photograph shows how one HIGH-QUALITY MOTOR OIL "peeled" off almost all of this test strip of steel when it was placed in corrosive-moisture conditions similar to those in a cooling engine. The oil concentrated at one spot and the unprotected surface quickly rusted.

RPM COMPOUNDED MOTOR OIL kept this strip bright and shiny, completely sealed against rusting, when it was exposed to the same conditions. "RPM" compounds keep a constant rust-proofing lubricant film on engine parts at all times, whether they are idle or moving.

How RPM Motor Oil Rust-Proofs As It Lubricates

Rusting, caused by corrosive moisture, is the greatest source of wear in automotive engines (85%, according to some engineers). It can be controlled by using RPM Compounded Motor Oil.

Additional compounding for "RPM," perfected by Standard of California scientists, provides a rust-proofing lubricant film on internal engine surfaces. The heaviest moisture condensation in idle or cold-running engines will not cut through it.

Other compounds in RPM Motor Oil give it adherent qualities so the film stays on parts at all times. They also loosen and remove gum and lacquer, lubricate hot spots, resist sludge formation, bearing corrosion and stop foaming.

Trademark "RPM" Reg. U. S. Pat. Off.

For additional information and the name of your nearest Distributor, write Standard of California, 225 Bush Street, San Francisco 20, Calif.; The California Oil Company, 30 Rockefeller Plaza, New York 20, N. Y.; The California Company, 17th and Stout Streets, Denver 1, Colo.; Standard Oil Company of Texas, El Paso, Texas.

FOR EVERY NEED A STANDARD OF CALIFORNIA JOB-PROVED PRODUCT

Boiler Feedwater must behave...

Dearborn Engineer making a water analysis in the field.

when your engineers,

Dearborn Research, and

Dearborn Service

work together

THE most baffling water treating problems are solved through the cooperation of technically trained and research-minded water-treatment engineers together with your engineering staff.

Operating difficulties with respect to the water and steam cycle are "ironed out" when these forces meet.

Scale deposits—corrosive action—steam contamination are effectively controlled by the use of correctively formulated treatments together with proper application methods and suitable test control procedure.

Dearborn service is the inexpensive scientific approach to your feedwater problems. Consult the near-by Dearborn Engineer or write to us direct.

ESTABLISHED IN '97
EXPLORING NEW HORIZONS IN '47

Dearborn

TRADE MARK REGISTERED

"THE LEADER FOR 60 YEARS"

ENGINEERING SERVICE AND WATER TREATMENT

Dearborn Chemical Company
Dept. F, 310 S. Michigan Ave., Chicago 4, Ill.
New York • Los Angeles • Toronto

Composite View of Dearborn laboratory and Plants in Chicago.

XUM

LOOK TO THE FUSE LEADER FOR PRODUCTION PROGRESS

WARE HI-LAG *Renewable* FUSES

THE FUSE THAT PREVENTS EXCESSIVE HEATING AND NEEDLESS BLOW-OUTS—GIVES 100% PROTECTION

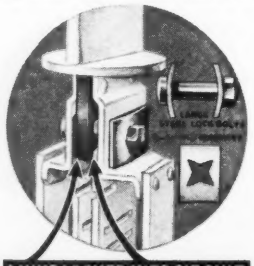
Cool Facts No. 3

NON-HEATING CONTACTS

The wide contact surface maintains low contact resistance.

Spring tension on links locked into position, prevents loosening of contacts, which causes over heating.

Connections held firm by large arched spring steel washers and heavy bolts.



LINKS LOCKED INTO CIRCUIT

APPROVED BY UNDERWRITERS' LABORATORIES

End once and for all times the unnecessary delays—shut downs—interruptions and costly expense resulting from out-of-date fuses.

Modern science has developed the coolest operating fuse in the WARE HI-LAG—the SAFE—ECONOMICAL and FOOL PROOF Fuse, giving greatest satisfaction and service with full protection.

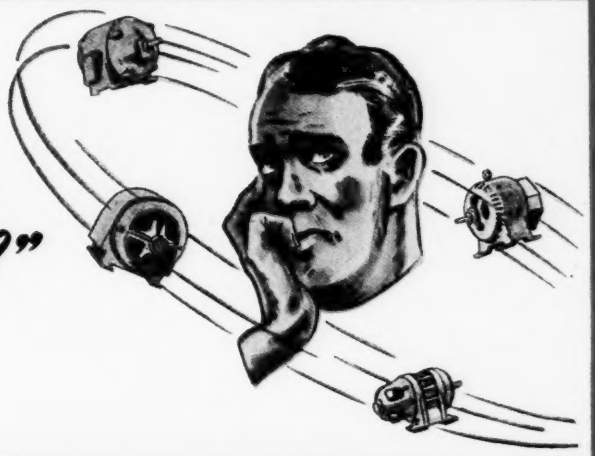
The reasons for WARE HI-LAG Super Performance are—higher lag for starting loads and surges—greater strength and durability—link designed for maintaining low resistance—non-heating, spring tension contacts with greater contact area. These are features which save time, expense and renewal costs. Start economizing!

We manufacture all of our own parts and are making prompt deliveries.

Write for Brochure giving details of all the COOL FACTS, sizes and prices.

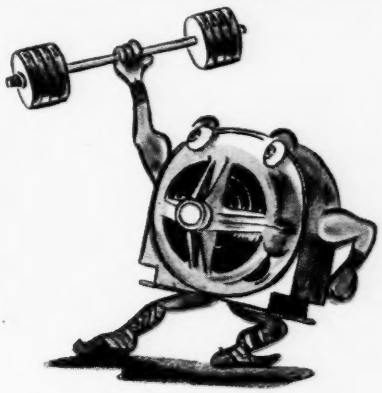
WARE *Brothers* 4450 W. LAKE ST.·· CHICAGO 24, ILL.

"Puzzled over which type of motor to buy?"



In 80% of the Cases, open squirrel-cage induction motors meet the need. They fit most drives, and can be obtained in numerous standard and special designs to meet varying conditions of starting torque, slip, etc. They are also the most economical type to buy and to maintain. Allis-Chalmers builds induction motors in sizes from ½ to 10,000 hp — or higher, if needed.

For Tough Starting Conditions, wound-rotor induction motors are recommended. Their high starting torque, at comparatively low starting current, and their controllable speed characteristics are desirable in drives for conveyors, grinding mills and other tough starting assignments. Compact, accessible Allis-Chalmers wound rotor induction motors range in size from 5 to 10,000 hp.



For Slow Speed, direct-connected drives as low as 75 rpm, or other constant speed applications at higher rpm, synchronous motors are a good solution. They are of particular benefit when a system's power factor is low, since they can be furnished for operation at either unity or leading power factor. From 40 hp to 50,000 hp and higher — in bracket bearing, pedestal bearing, or engine types.

Is d-c Available? Then adjustable speed operation is easily obtainable. Allis-Chalmers builds d-c motors from ½ to 10,000 hp and higher — for constant or adjustable speed duty in ranges of 6:1 and lower. By means of a source of d-c voltage, adjustable speed motors may also be designed to operate over a speed range as high as 30:1. Suitable for fans, elevators, etc.

Select from the Complete Allis-Chalmers Line!

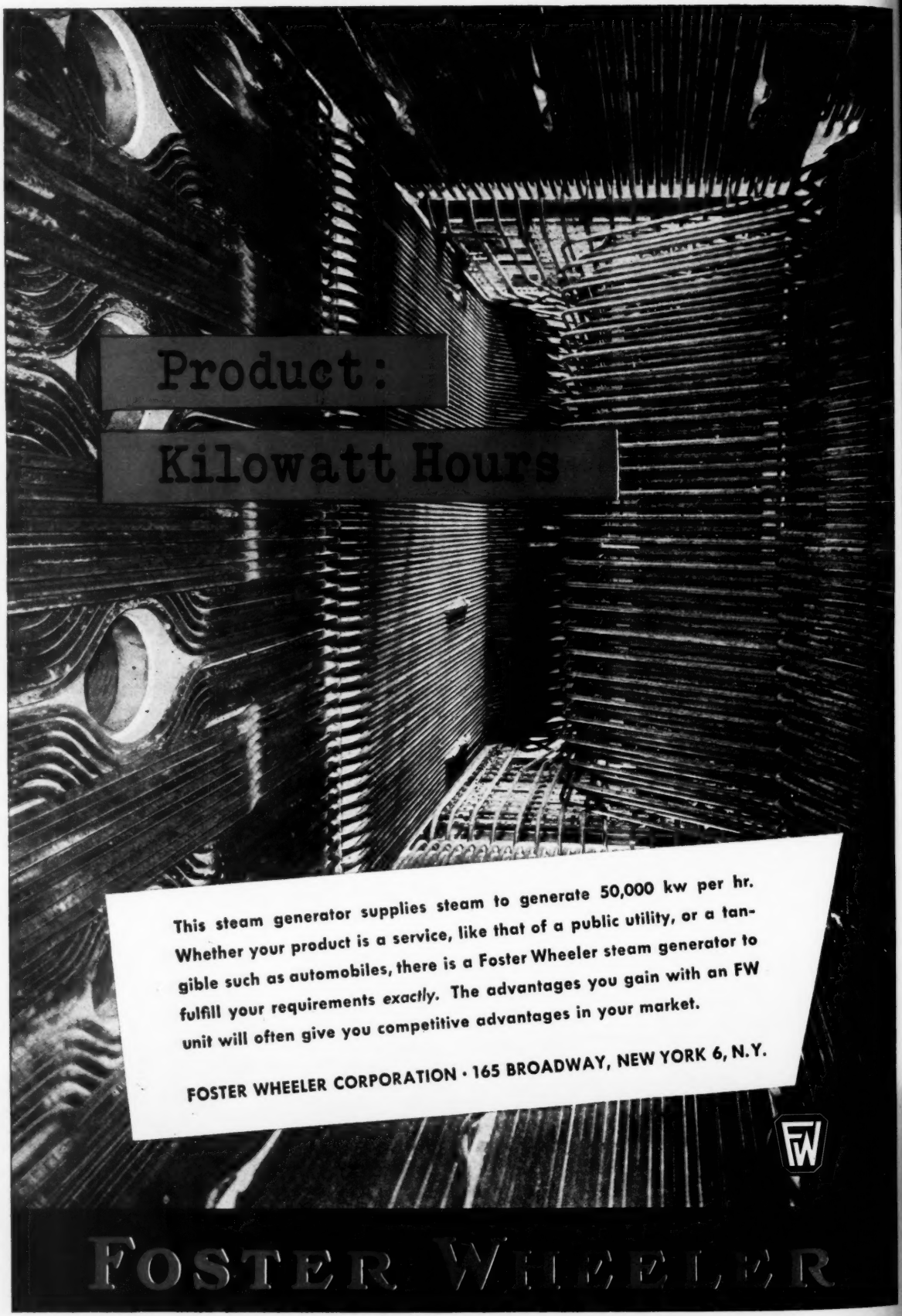
NOT JUST FOLLOWING popular choice and using a standard squirrel cage induction motor. But the *right* motor for economy and efficiency.

That means an overall knowledge of *all* types of motors . . . their operation . . . limitations . . . maintenance. And there's where your A-C representative can be a big help. His recommendations are backed by experience . . . and the Allis-Chalmers motor he selects is *itself* backed by 50 years of experience in motor design and building. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 2304

1847 1947
A CENTURY OF SERVICE to Industry THAT MADE America Great

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment-
Biggest of All in Range of Industrial Products


Product:
Kilowatt Hours
This steam generator supplies steam to generate 50,000 kw per hr. Whether your product is a service, like that of a public utility, or a tangible such as automobiles, there is a Foster Wheeler steam generator to fulfill your requirements exactly. The advantages you gain with an FW unit will often give you competitive advantages in your market.
FOSTER WHEELER CORPORATION · 165 BROADWAY, NEW YORK 6, N.Y.
FW
FOSTER WHEELER

DOWELL

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

How much POWER

—can Dowell chemical cleaning restore for you?

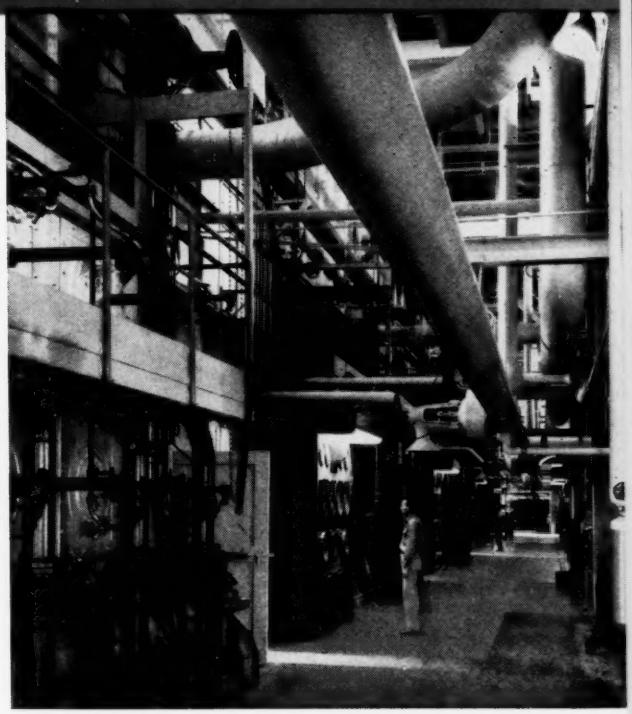


Figure it in dollars and cents: How much power are you losing due to accumulations of scale and sludge in boilers, condensers and other heat-exchange equipment? How much is it costing you for the extra fuel required to overcome the reduced efficiency imposed on your plant by *insulating deposits?*

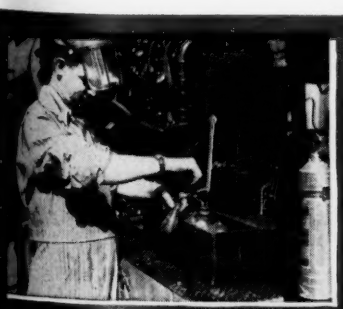
Take a good look at your designed operating efficiency—and compare it with the *actual output* you are securing. Then call the nearest Dowell office for the facts and figures on *chemical* scale removal service.

Leading plants everywhere rely upon Dowell service—including some of the largest boiler installations in the nation. They tried Dowell service and found it rapid, safe and economical. They've seen Dowell engineers fill plant equipment with liquid solvents designed to dissolve and disintegrate scale and sludge—and they've seen the *results.* You'll make no mistake to follow their example—get the facts.

DOWELL INCORPORATED • TULSA 3, OKLAHOMA

New York, Boston, Philadelphia, Wilmington, Baltimore, Pittsburgh, Buffalo, Cleveland, Cincinnati, Detroit, Chicago, St. Louis, Kansas City, Wichita, Oklahoma City, Houston, Fort Worth, Shreveport, Mt. Pleasant, Michigan; Salem, Ill.; Borger, Texas; Wichita Falls, Texas; Midland, Texas; Lafayette, La.

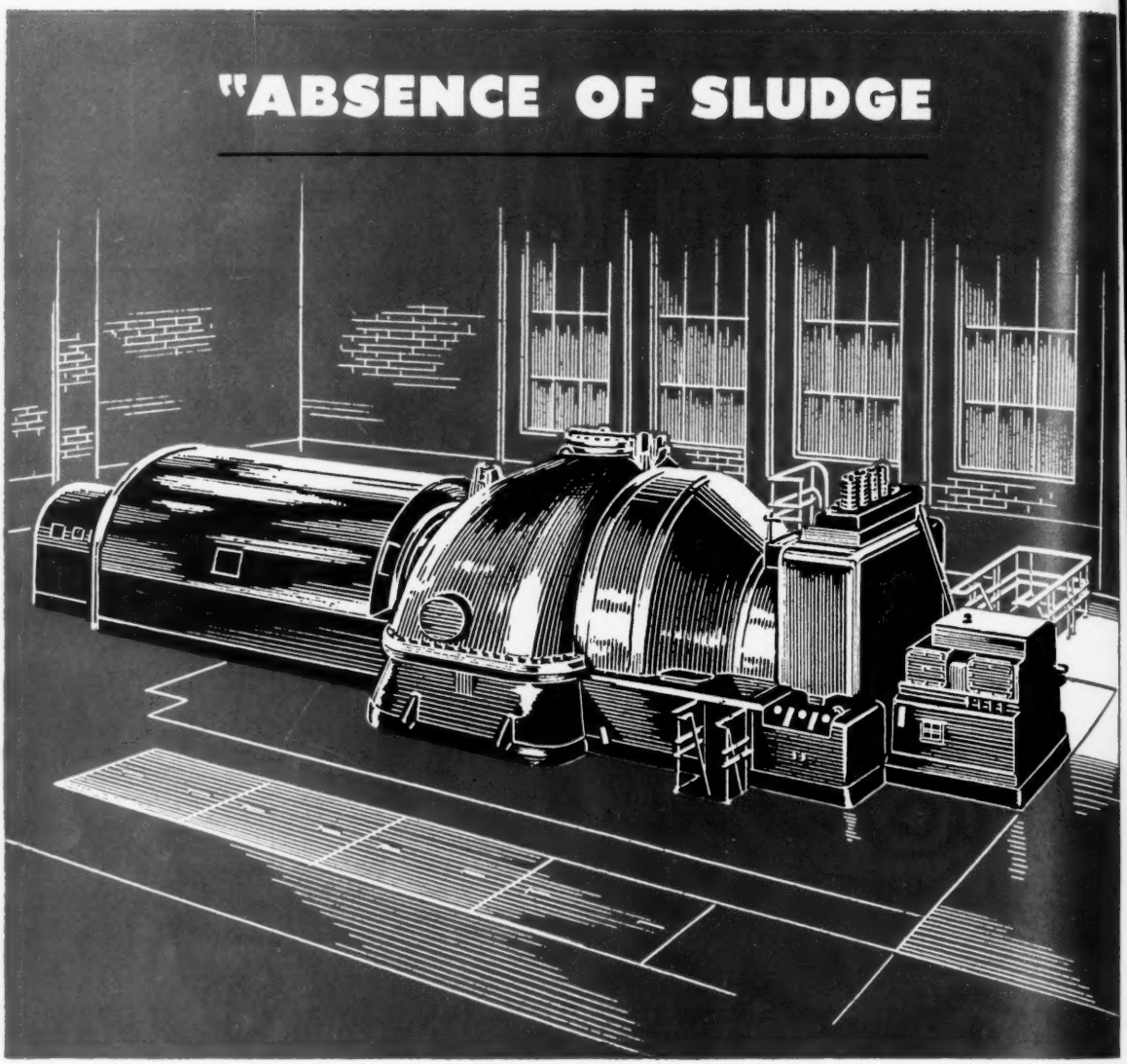
Long Beach, Casper: Dowell Associate—International Cementers, Inc.



DOWELL

FOR INDUSTRIAL CHEMICAL SERVICE

"ABSENCE OF SLUDGE



. . . with Tycol turbine oil"

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
Chicago • Detroit
Pittsburgh • Philadelphia
Tulsa • Cleveland
San Francisco

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N. Y.

"Fifteen years without oil change . . .

Oiling system clean at all times . . .

Low maintenance costs . . .

Tycol turbine oils used exclusively . . ."

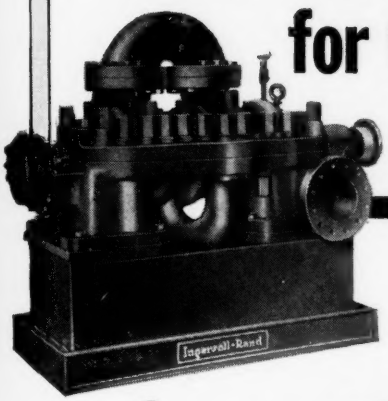
—that's how one general superintendent describes the superior qualities of Tycol Turbine Oils.

"These qualities are extremely important to us," he added, "and have, of course, resulted in low maintenance costs".

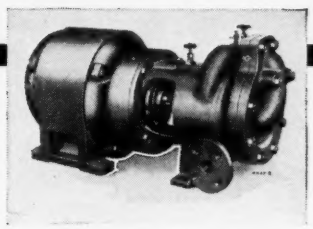
For full details concerning Tycol Turbine Oils, call, write, or wire your nearest Tide Water Associated Office.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

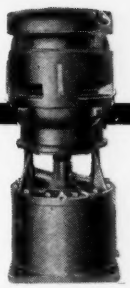
BOILER-FEED PUMPS
for the Exacting Engineer



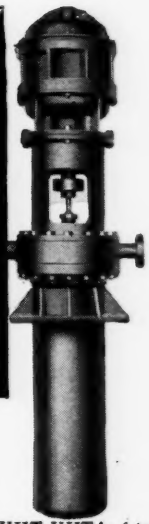
RT: 4 to 8 stages; pressures to 1200 lb, capacities to 2000 gal per min.



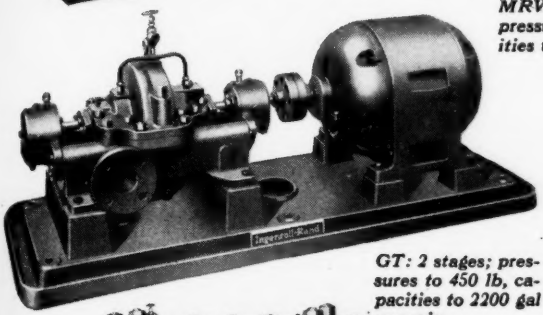
MRV: 2-stage Motorpump, pressures up to 200 lb, capacities to 275 gal per min.



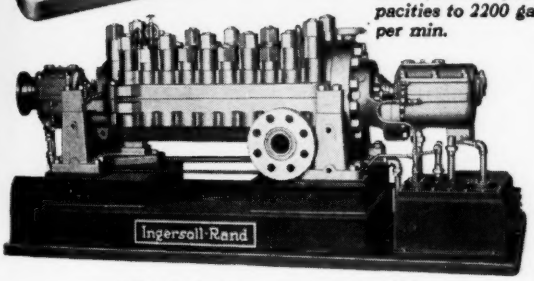
MRVH: 4-stage Motorpump, pressures to 260 lb, capacities to 75 gal per min.



VHT-VHTA: 4 to 30 stages; pressures to 1500 lb, capacities to 350 gal per min.



GT: 2 stages; pressures to 450 lb, capacities to 2200 gal per min.



Here is a line of feedwater pumps that satisfies, yes, even exceeds, the specifications of the most exacting boiler plant engineer. That's because there's a lot of clear thinking, a superb research organization, and 75 years experience behind the Ingersoll-Rand Cameron line of boiler-feed pumps.

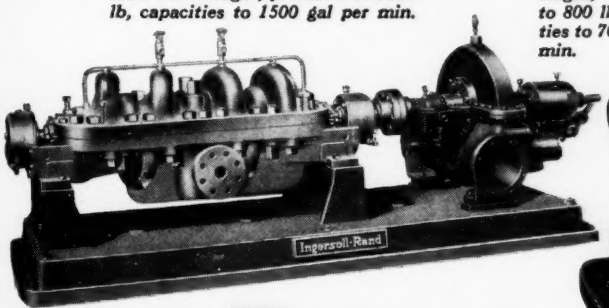
There is a pump in this line-up for any plant from the smallest to those big, high-pressure jobs that make the headlines. Regardless of size and duty, they are all built with the same exacting care that has made the trademark, I-R, a symbol of confidence in the field of hydraulics.

Call your nearest I-R engineer for literature or consultation. There's no obligation—just the desire to help you get the best in performance and long service.

CHT: 6 to 8 stages; pressures to 3000 lb, capacities to 2500 gal per min.

CNT: 4 to 8 stages; pressures to 800 lb, capacities to 700 gal per min.

HT: 4 to 9 stages; pressures to 1600 lb, capacities to 1500 gal per min.



SEVENTY-FIFTH ANNIVERSARY

COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO BLOWERS • CONDENSERS
CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

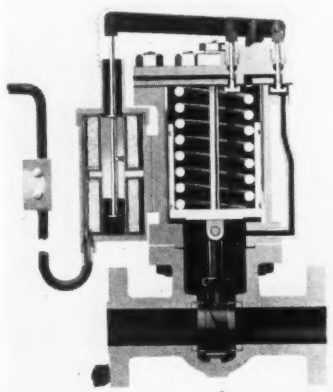
10-877

NEW EQUIPMENT NEWS

Use the coupon below when you want further information on the equipment described on this page and following pages. Write the identifying letter or letters in the space provided, clip the coupon and send it to Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois

A Electric Valve Control.

These new valve controls are said to function efficiently, extend valve life and provide smooth, trouble-free control in the handling of air, water, oil, gas and steam whether at high or low pressure or temperature. It is pointed out that no current is required to maintain the valve in either open or closed position. Only three wires to the control and two



control switches at the operating center are required to control the valve. Since the solenoid coils need only be energized momentarily the control will operate on either 110 or 220 a-c or d-c current.

Other features pointed out by the manufacturer, Shafer Valve Co., Inc., include the elimination of constant exhaust, fast or slow operation, control of water hammer, and automatic shut off.

B Electric Impact Tool.

Ingersoll-Rand announces a new universal electric, all-purpose impact tool. Using standard attachments, it will apply and remove nuts—drill—ream—tap—drive and remove screws—drive and remove studs—extract broken cap screws and studs—run wire brushes—do hole saw work—drill brick and masonry—drive wood augers.

This new machine is designated as the Size 4U. It weighs only 6½ lb., has an over-all length of 10½ in., a free speed of 2000 rpm, and delivers 1900 rotary impacts per minute under load. It is powered with a specially designed reversible, universal, electric motor (3 amp.) that operates on 110 v, a-c—d-c current.

The Impact Tool runs just as any conventional electric tool until the resistance to spindle rotation reaches a certain amount. Then a patented mechanism converts the power of the motor into "rotary impacts" which exert a more powerful turning effect than is produced by any other electric tool of comparable size.

An outstanding advantage of the impact mechanism is that it permits the spindle to be stalled completely while the motor continues to run; thus eliminating motor burn-outs caused by overloading. The impact mechanism also eliminates torque reaction to the operator. There is no kick—no twist—under any condition.

The following operations can be easily performed with the Impact Tool using standard attachments:

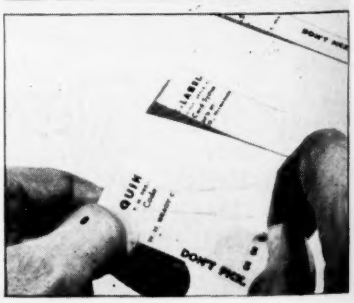
Apply and remove nuts—the unit is conservatively rated to handle nuts and cap screws up to ⅜ in. thread size. Drill—Rated for ¼ in. drilling in metal—up to ½ in. by step drilling. Ream—Reamers up to ½ in. diameter. Tap—Taps from ¼ in. to ½ in. Drive and remove screws—All types of machine screws up to ⅜ in. thread size and wood screws up to size No. 20. Drive and remove studs—Capacity up to ⅜ in. thread size. Extract broken cap screws and studs—Up to ⅜ in. thread size. Run wire brushes—Various types of wire brushes with round shanks up to ⅜ in. diameter. Wood-boring—Up to ⅜ in. twist drills with collet-type chuck; up to 29/32 in. with Morse Taper. Drill brick and masonry—Carbide-tipped drills up to ⅜ in. diameter.

C Wire Marking Labels.

The standard cards on which self-adhesive Quik-Label Wire Markers are mounted now come equipped with two Self-Starter Strips. Standard cards have one row of 1½ in. long labels and with this new feature the labels can be cut in half to make each label ¾ in. long.

The first Self-Starter Strip, as shown in the top picture, aids in the removal of the top row of ¾ in. long Quik-Labels by automatically exposing the end of each label for you to grasp instantly.

After the top row of labels has been used, the second Self-Starter Strip is removed to expose the ends of the ¾ in. long labels in the second row, as



SEPTEMBER, 1947

POWER PLANT ENGINEERING

53 W. Jackson Blvd.
Chicago 4, Illinois

Please have the manufacturers send me without obligation further information on the equipment indicated by the following letters:

.....
.....
.....
.....
.....

Please Print Clearly

Your Name.....

Your Title.....
Your Company Name.....

Company Address.....

City.....State.....

(If you prefer delivery at your home also fill in below)

Home Address.....

City.....State.....

DEPARTMENT OF TECHNOLOGY
BUFFALO PUBLIC LIBRARY

XUM

TIGHT VALVES *Save Fuel!*

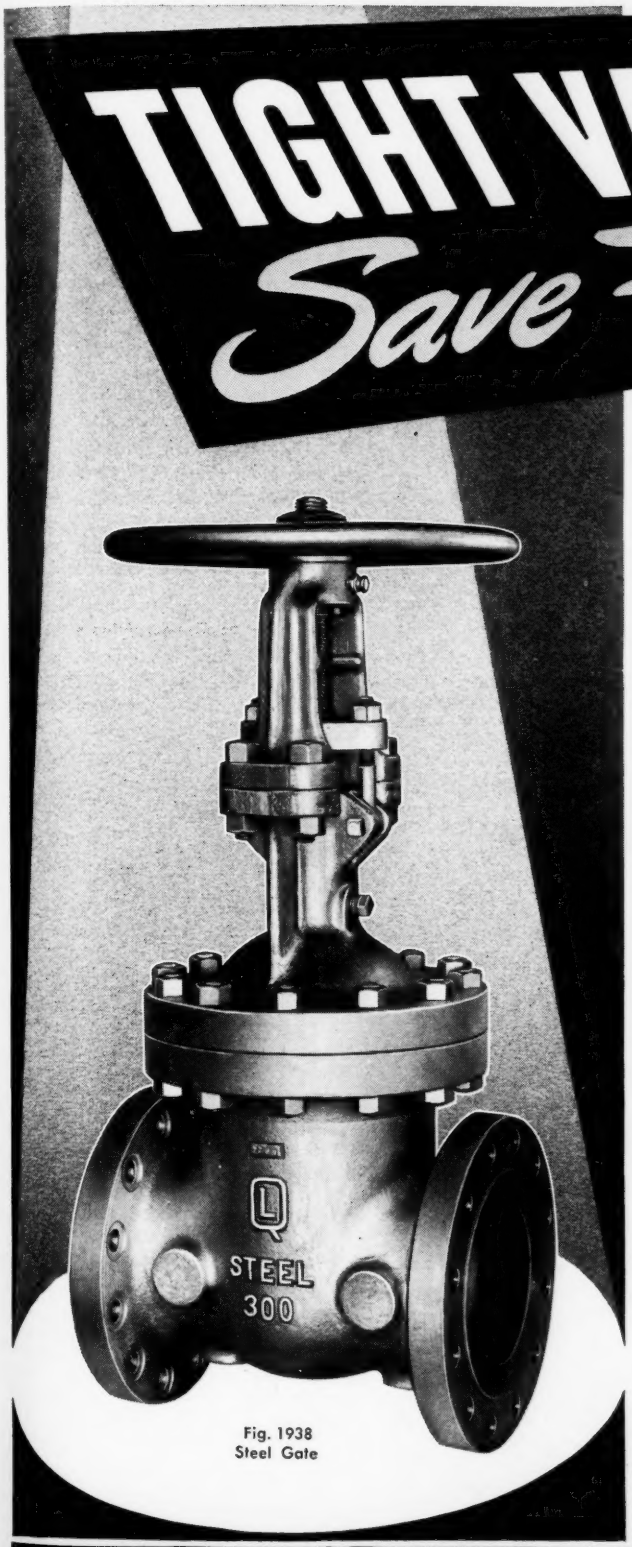


Fig. 1938
Steel Gate

VITALLY IMPORTANT—*for keeping*

PRODUCTION *Up*

• • • • COSTS *Down*

Many elements in a piping system may contribute to ultimate fuel waste. Insulation may be inadequate. Piping and fittings may be at fault. Or valves may fail to hold tight . . . resulting in leakage of steam, air, or water, and in lowered pressures, all of which may mean excessive fuel consumption.

Lunkenheimer Valves—whether of steel, iron, or bronze—are quality built to stay tight, over years of service. They afford constant, dependable protection against leakage. Simplicity of design and a minimum of working parts assure extra long life and easy, economical maintenance.

We have prepared a chart, showing in dollars-and-cents figures, what leaky valves can waste in steam, water, and air. For a copy, write—**The Lunkenheimer Co., Cincinnati 14, Ohio. U. S. A.** New York 13, Chicago 6, Boston 10, Philadelphia 7. Export Dept. 318-322 Hudson St., New York 13, N. Y.

Your LUNKENHEIMER DISTRIBUTOR

is fully equipped to help you solve problems of valve maintenance or operation. Call on him . . . you'll profit from his better valve service!

LUNKENHEIMER VALVES

BRONZE, IRON, STEEL, AND CORROSION RESISTANT ALLOY VALVES
AIR DEVICES, LUBRICATORS, AIRCRAFT FITTINGS

shown in the bottom illustration. Thus you can now get twice as many labels on a card, and the shorter ¾ in. labels are particularly suited for marking smaller diameter wires.

The manufacturer announces that all 500 stock Quik-Label cards now have two Self-Starter Strips and that any card can be furnished with either 1½ in. long labels for marking large wires, or ¾ in. long labels for wires of smaller diameter. Orders for stock cards are shipped immediately. Literature is available from W. H. Brady Co.

D Tachometer Indicator. A new tachometer indicator for flush mounting on switchboards has recently been added to Metron Instrument Co's. line of speed measuring equipment. The total projection is only ¾ in. from the panel surface on which it is mounted. This indicator is supplied in any one of 50 standard scales covering speeds from 1 rpm to 100,000 rpm, and multiple range features can be incorporated.

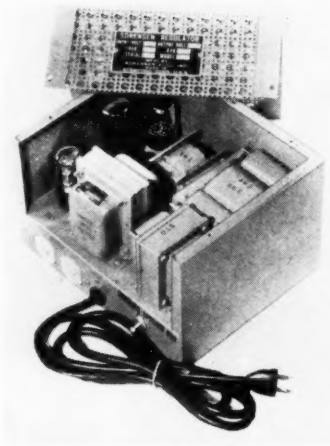
It can be used with any of the Metron tachometer heads for hand or fixed engagement for speed measure-

ment. This flush mounting indicator is sometimes equipped with a rotary selector switch so that any number of tachometer heads can be used with a single indicator to monitor speeds of several machines from a centralized location.

The panel dimensions are 7½ in. wide and 9¾ in. high with a projection of 4⅝ in. behind the front surface of the panel. Connections are made to terminals on the rear.

E Voltage Regulator. A low cost, general purpose portable a-c voltage regulator, featuring electronic control circuits and designed specifically for component applications with electrical equipment utilizing light loads, has been announced by Sorensen & Co.

The new regulator, designated Model 150, has an input voltage range of 95 to 125 volts a-c with an output of 115 v. Regulation accuracy is ½ of 1 per cent and maximum harmonic distortion is 5 per cent. Other important features include a load range of 10 per cent to 100 per cent, a frequency range of 50 to 60 cycles and a power factor range of 70 per cent lagging to 90 per cent leading. Maximum recovery time is six cycles.



Extremely adaptable to a wide range of equipment, Model 150 is ideally suited for incorporation with electrical apparatus where good regulation at low cost is needed. Among the many applications for the new model are with laboratory, production and quality control test equipment, with high frequency oscillators for regulation of filament and plate supplies and with photometric apparatus.

F Permanent Non-electric Pulley. A completely self-energized magnetic pulley requiring no electric current to generate a magnetic field is now being commercially produced by Eriez Manufacturing Co. This pulley is adaptable to all applications requiring automatic separation of magnetic from non-magnetic materials conveyed on a belt.

The preparation of metal-free coal at the mine is being simplified by this new permanently magnetized pulley. It can be installed deep in the mine on a portable conveyor or high in a tipple without need of current, wires, transformers, rectifiers, etc.

The self-cleaning unit is often installed out-of-doors removing tramp iron from coal ahead of crushers and pulverizers. Neither intense heat, rain or sudden temperature changes affect its proven magnetic efficiency.

The unit will work effectively through belts of rubber, canvas, leather or any other non-magnetic material, thereby performing automatic separation.

Powered by giant Alnico Alloy Magnets these non-electric pulleys have, in many cases, been placed in hazardous locations where possible sparking has precluded the use of electrically powered magnetic separators.

Other advantages are that it always operates at top efficiency as the permanent magnetic strength is not affected by electric current variations and that it virtually eliminates operation and maintenance costs.

G Induction Motor. Newly announced two-pole squirrel-cage induction motor is an addition to Electric Machinery Mfg. Co's. "Heavy-Duty" line, for such high-speed applications as boiler feed pumps, oil pipe line pumps, centrif-

ugal pumps, compressors and blowers. Rated from 200 to 700 hp at 3600 rpm; NEMA Class B starting (normal torque, low current) favorable for across-the-line starting. Drip-proof construction; fabricated steel frame.

Motor is engineered to meet the exacting requirements of high-speed service: (1) Kolene Process centrifugally-cast bearing sleeves, (2) pressure-lubricated bearings available, (3) split bearing brackets (doweled) permit easy access to bearings, (4) windage noise lessened by design to avoid abrupt acceleration of air, (5) phos-copper braze-welded cage winding.

H Abrasive Flooring Cement. A new abrasive cement especially designed to eliminate slipping and tripping hazards on worn stairways and uneven floors has been recently developed by and distributed by Duracite Sales Co.

This cement, known as Duracite, comes in dry powder form, and is made into mortar by adding plain

for Power or Process piping . . . everything's in the CRANE line

Valves, fittings, or pipe line accessories . . . pipe or shop-fabricated piping units . . . whatever you need for new installations or replacements . . . most likely Crane supplies it. And with good, dependable quality in every single item.

On this water treating installation, for example, here's how the complete Crane line helps simplify the whole piping job. You specify from one catalog . . . get everything on one order to your local Crane Branch or Wholesaler. From start to finish, the job moves fast and smooth . . . with good piping performance assured. Because when you standardize on Crane materials, you get this 3-way advantage:

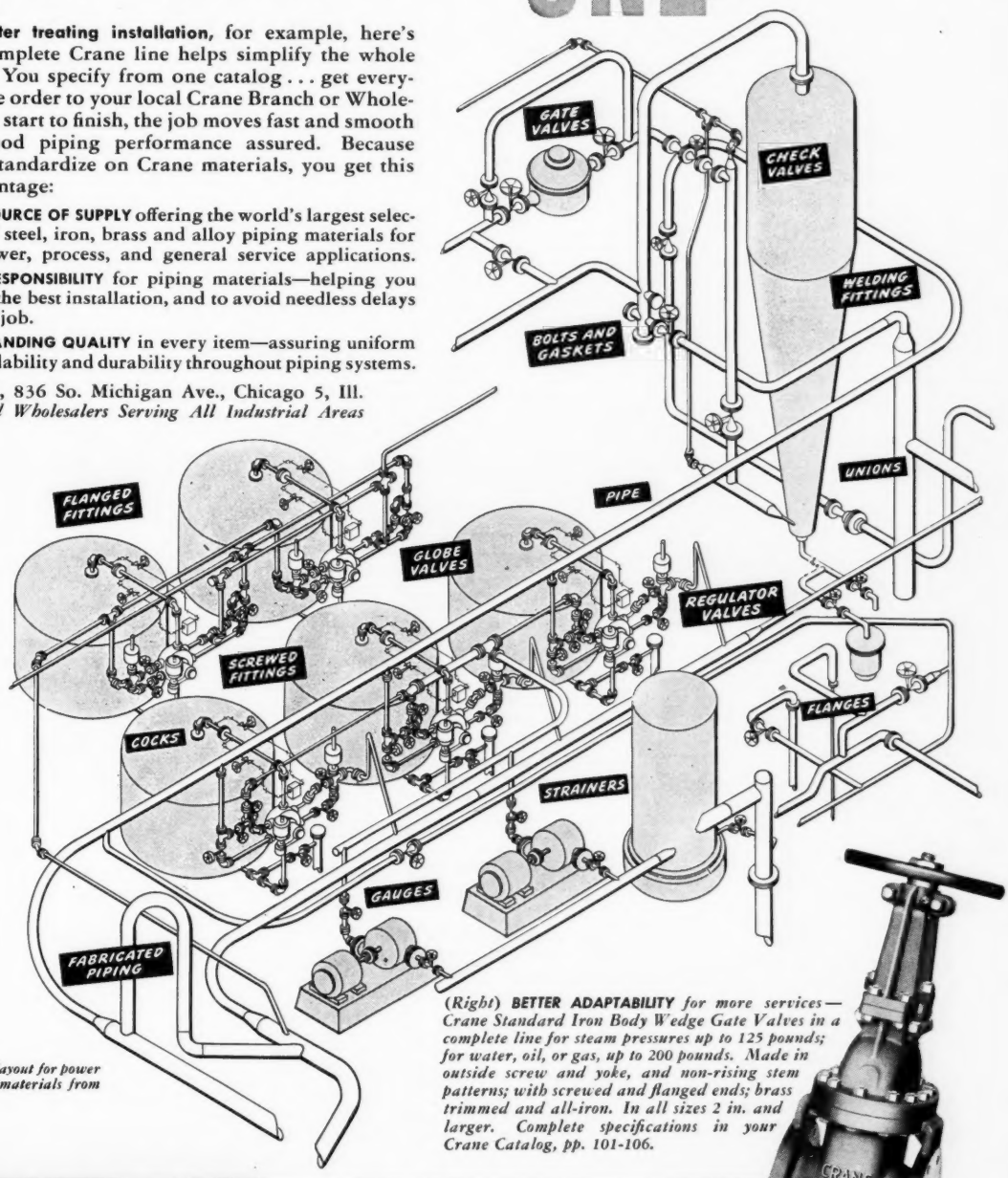
ONE SOURCE OF SUPPLY offering the world's largest selection of steel, iron, brass and alloy piping materials for all power, process, and general service applications.

ONE RESPONSIBILITY for piping materials—helping you to get the best installation, and to avoid needless delays on the job.

OUTSTANDING QUALITY in every item—assuring uniform dependability and durability throughout piping systems.

CRANE CO., 836 So. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY



Water treating layout for power plant . . . piping materials from Crane.

(Right) **BETTER ADAPTABILITY** *for more services—Crane Standard Iron Body Wedge Gate Valves in a complete line for steam pressures up to 125 pounds; for water, oil, or gas, up to 200 pounds. Made in outside screw and yoke, and non-rising stem patterns; with screwed and flanged ends; brass trimmed and all-iron. In all sizes 2 in. and larger. Complete specifications in your Crane Catalog, pp. 101-106.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

water. The mortar is easily applied with a trowel.

In addition to the permanent slip-proof effectiveness of Duracite under wet or dry conditions, this cement is said to form a solid bond with such difficult bases as slate, marble, concrete, wood, etc., even when applied to a feather edge of only 1/16th in.

The Duracite surface will support foot traffic six to eight hours after installation, and will attain a granite-like hardness when fully set. It can be colored to either match or contrast with the base.

J Level and Angle Indicator. This indicator is designed for ascertaining angles on any type of industrial work, for ascertaining belt and pulley angles, setting machinery, installing shafting, brackets, etc.

The indicator is usable from all four surfaces with the vials visible in any position with the added features of quickly determining angles, pitches

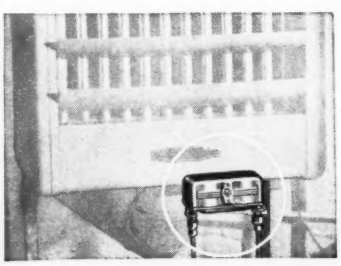
and inclines to a high degree of accuracy. The dial indicator is described as sensitive and exact, the dial is made of clear, tough plastic calibrated in degrees (0-360) and graduated in such a manner as to make it practical for use by the most painstaking craftsman.

The frame is of heat treated aluminum 16 in. long, 3 in. wide and ¾ in. thick. It is announced by R-D Company.

K Humidifier, A new development in the field of air conditioning is the "Atomick" humidifier. It is a simple, inexpensive device for adding humidity to indoor atmospheres. It is designed particularly for use in those industries where the year-'round maintenance of proper humidity is vital to production and uniformity of product.

The single spray "Atomick" humidifier will atomize up to 1¼ gph of water while the 4-spray unit will handle four times as much. It is air operated. Where a compressed air line is not available, a small compressor, such as artists use, may be employed.

During the heating season, in all types of industrial plants and office buildings, the "Atomick" humidifier provides an ideal, low-cost method of



insuring adequate humidity for health, comfort and fuel economy. It can be applied in conjunction with steam, hot water or gas-fired unit heaters, or used independently where direct radiation or warm air furnaces are installed.

When "hooked in" for service with unit heaters, humidification starts when the unit heaters "come on," and the "Atomick" humidifier continues to deliver a mist of water vapor directly into the warm air flow for as long as the unit heater is in operation (see accompanying cut). If this arrangement tends to result in too much humidity, the "Atomick" humidifier may be controlled separately by a humidistat. In hot, dry climates, the units can be used for cooling purposes. It is announced by Maid-O-Mist Inc.

L Tachometer Angle Adapter. Type 45 angle adapters for use with Metron Instrument Co's. hand tachometers are now available. They permit the measurement of speed in cramped quarters where the clearance at the end of the rotating shaft is as little as 2 in. They are also useful with the Type 61 disc for measuring linear speeds where clearance to the sides of the moving member is limited.

The angle adapter slips readily over

the standard hand type head. It is precision built and consists of a pair of miter gears supported on permanently lubricated ball bearings. This insures smooth running and long life. The tachometer carrying case has space provided for this adapter along with the tachometer itself. The cost of the adapter is $36.50 and delivery is currently being made from stock.

M Electronic pH Meter. The new pH Meter combines the high accuracy of a laboratory-type instrument with the ruggedness and simplicity of operation of an industrial model. The large indicating meter is equipped with a 7 in. scale and mirror for convenient readings and high precision. The meter covers the complete pH range, no reversal switch being required. It is announced by Photovolt Corp.

The instrument is always ready for immediate readings. It is standardized with the aid of a single buffer solution and a single control knob. A tell-tale hand is provided to mark the reference point. This makes it possible to restandardize the instrument in the course of actual measurements without the use of a buffer. A wide range temperature control from 0-100 C obviates the necessity of consulting temperature correction charts.

No batteries are employed. The instrument operates directly on any a-c power line of 50-60 frequency. A voltage selector is provided to make it useable on any voltage between 90 and 275 v. The instrument is fully stabilized for line voltage fluctuations and does not depend on stable frequency of the alternating current. It can be left turned on continuously.

O Pressure Control Pilot. An "all-purpose" Pressure Control Pilot for use with diaphragm regulating valves has been announced by Leslie Co. The Control Pilot is a simple and positive mechanical device used to control the action of a diaphragm regulating valve so as to maintain a constant controlled pressure and regulates operating pressure (air, clean gas, water or light oil) to a standard diaphragm regulating valve in the flow line of the fluid to be controlled.

Economical operation is assured because there is no continuous leakage of operating pressure, particularly important for "stand-by" applications.

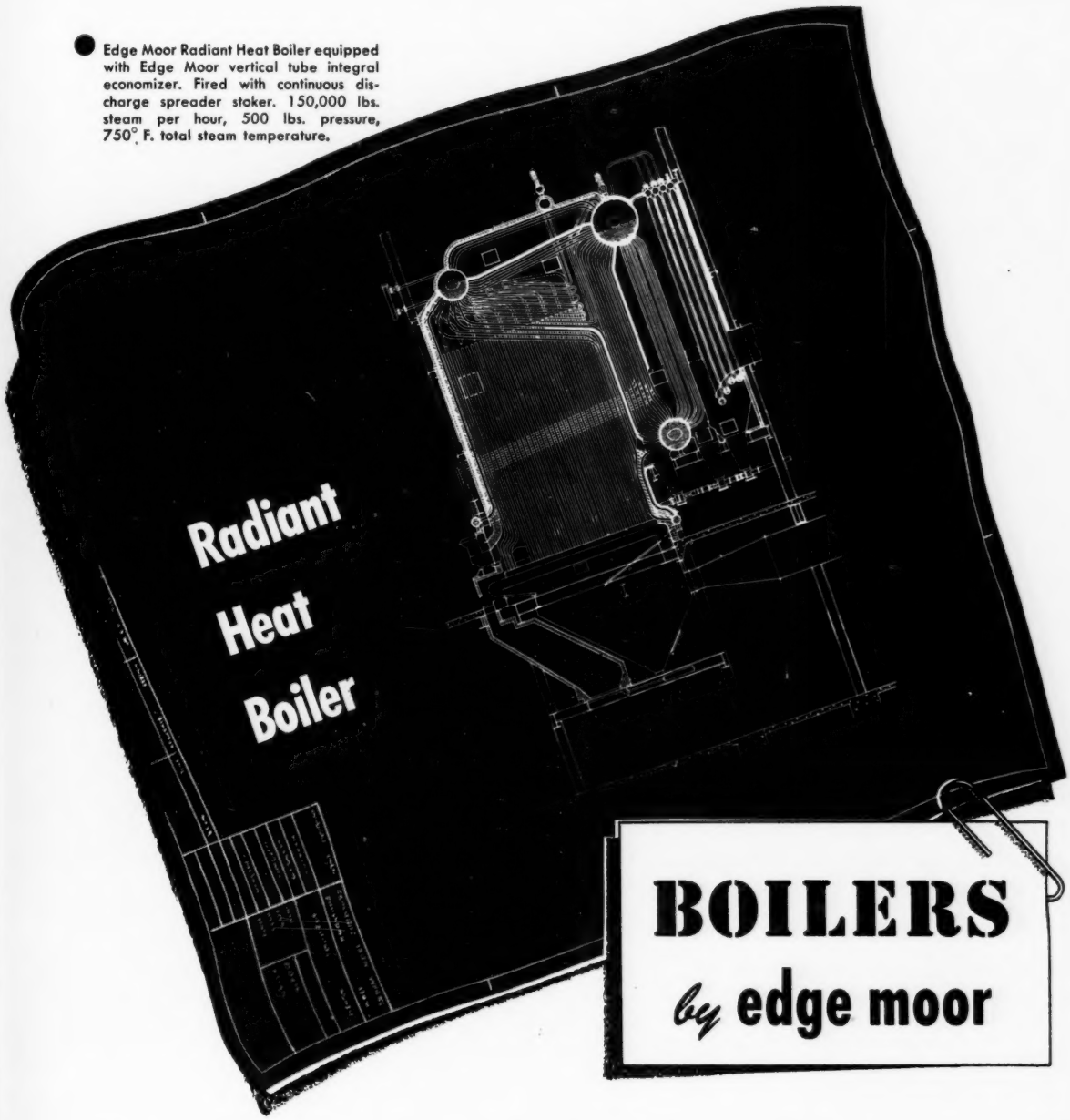
The Pilot is extremely rugged and reliable, requiring no attention over long periods and no recalibration during service. They are made in nine controlled pressure ranges from ½ to 800 psi.

P Safety Valve. Manning, Maxwell & Moore, Inc., has just released for sale a new safety valve for air compressors, utilizing a nylon disc.

The use of nylon as a material for safety valve seats is said to be new. Search for a satisfactory safety valve seating material for compressed air is as old as the industry. So far, nylon is reported to be the only material found which possesses all the essential characteristics of wear resistance, hardness and flexibility.

This new valve meets all ASME requirements for air compressor service. It has been flow-tested and discharge capacities are guaranteed.

Q Insulation Tester. A new tester developed by Radio Frequency Laboratories, Inc., measures insulation resistance of power cables, transformers, condensers, switches and wiring assemblies at any desired d-c voltage up to 10 kv. Breakdown voltages also can be accurately determined with a minimum of damage due to burning. Two separate circuits measure high resistance at the desired test voltage. Full man-



Edge Moor Radiant Heat Boiler equipped with Edge Moor vertical tube integral economizer. Fired with continuous discharge spreader stoker. 150,000 lbs. steam per hour, 500 lbs. pressure, 750° F. total steam temperature.

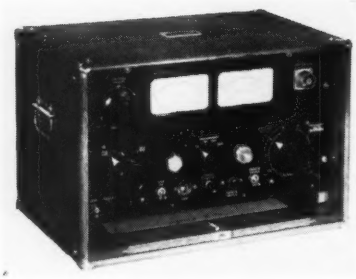
BOILERS *by* edge moor

THE dependability, efficiency and flexibility of this unit has been made possible by 80 years of Edge Moor designing and engineering skill. Its design provides for a large water storage, generous steam liberation surface and quiet offtake drum. Maximum boiler tube surface is exposed to radiant heat and furnace cooling is arranged for a minimum of maintenance. This quick-steaming unit delivers continuous high ratings over many years and is adaptable to all fuels.

This and other types of Edge Moor boilers are available in a wide range of capacities, pressures and accessory equipment. Write for literature today. EDGE MOOR IRON WORKS, INC. Main Office and Works: Edge Moor, Delaware. Branch Offices and Agents: Atlanta, Boston, Chicago, Detroit, Hoboken, St. Paul, San Antonio and San Francisco.

edge moor steam generating equipment

EM



ual control is provided for selecting any output voltage up to the maximum.

Resistance ranging from 0.1 to 50,000 megohms may be read directly on a megohmmeter scale at open circuit voltages of 0.5, 1, 5, and 10 kv, or may be simply calculated in ranges from 0.3 to 20,000 megohms from the readings of a voltmeter and microammeter connected to read resistance at any desired test voltage from 100 v to 10 kv. Either of the alternate methods are selected on one switch. Leakage current ranges are 30, 150, 300 and 1500 microamperes, readable at any voltage. For polarization checks, a polarity reversing switch allows either the positive or negative side of the voltage supply to be grounded. The tester operates from a 115 v 60 cycle line and consumes a maximum of 65 watts.

R For Leaky Boilers. Heating contractors and engineers will be interested in the new Plumber's Boiler Fuse, developed by The Penetone Co. The product, a liquid, is a colloid which seals leaks

in high and low pressure boilers, radiators, piping, valves, heaters, etc. When poured into the heating system or boiler, it is said to immediately fill in the leaks with a lasting, pressure-resistant seal.

Plumber's Boiler Fuse contains no solids which would interfere with the circulation of the heating system.

S Valve Reseating Tools. The new pivot valve reseating tool employs aluminum-oxide discs mounted on both sides of a wafer-thin steel body and is so constructed that the tool is operated by means of a brace equipped with a screw-driver bit. The tool is designed for use on globe, angle and check valves.

Because of its unique construction no special guides or jigs are required and it is not necessary to dismantle the bonnet and stem assembly of valve, therefore, the stem packing is not disturbed.

One side of the pivot tool has a coarse abrasive disc which enables one to rapidly grind away the seat defects while disc on other side is finer so that by reversing the tool a mirror-like finish can be put on the valve seat.

Pivot valve reseating tools are available in eight sizes for valves

from ½ in. to 3 in. inclusive and are packed in attractive hardwood cases in two sets, the No. 60 set for valves ½ in. to 2 in. and the No. 80 set for valves ½ in. to 3 in.

A generous supply of extra abrasives is furnished with each size tool. Manufactured by Grace Products Co.

T Water Softener. While the hot lime-soda process for softening boiler feedwater is one of the most effective methods of reducing both hardness and alkalinity, many of the older types of equipment for this purpose are wasteful of chemicals, says this manufacturer, and do not provide clear enough water from the settling tank ahead of the filters.

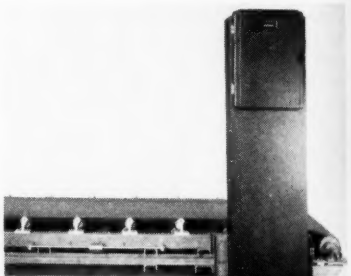
In order to obtain the benefits of this process to the greatest degree, Liquid Conditioning Corp. has developed a new design of hot lime-soda softener in five types which cover a wide range of plant conditions and requirements.

The equipment, known as the Liquid Hot Lime-Soda Softener, has a deep sludge bed or blanket through which the raw water percolates upwardly. This sludge bed performs several functions. It assures thorough contact of the water with the lime and soda ash which it contains, providing a high rate of completeness of chemical reactions. The magnesium hydroxide which the sludge usually contains also accomplishes a much greater silica removal. In addition, the sludge bed acts as a contact filter, reducing the turbidity and producing a clearer water than obtainable in older types of softeners. Therefore there is less load on the filters which follow the softener, so that these filters need not be backwashed so frequently.

The five types of Liquid Hot Lime-Soda Softeners which are available provide a selection for different make-up requirements up to 100 per cent, and for deaeration of make-up or of both make-up and condensate either separately or together. Each type includes provisions for chemical feed, vent condenser, filters with backwashing water recovery so that the wash water does not pass through or disturb the sludge bed in the softener, and special automatic desludging valve which controls the depth of the sludge bed.

U Conveyor Meter. A new development in the continuous weighing of dry materials on conveyor belts is offered by Builders-Providence, Inc., in the Conveyoflo Meter. This meter utilizes diaphragms instead of the usual knife-edge-beam principle for metering flow of dry materials by weight.

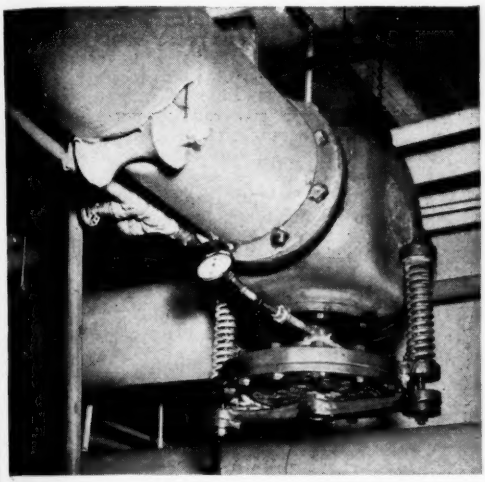
Industrial processes will benefit by the efficiency and high accuracy of the Conveyoflo Meter. These processes may involve continuous weighing of such materials as coal, gravel, stone, powdered chemicals, ore (newly mined and crushed), stemmed tobacco leaf, fruit, wood chips and sewage sludge. The scales may be used to proportion and control, as well as weigh, the feed of one or more dry materials such as cement, sand and gravel, ground rubber for reclaiming operations, batching of wood chips to digesters and controlling ore to ball



mills, and to control the flow of liquids in proportion to the flow of dry materials. The weighing section of the Conveyoflo Meter is supported at one end by self-aligning ball bearing pillow blocks, and at the other end "floats" on a diaphragm which transmits load changes hydraulically to the weighing mechanism. The cyclometer type totalizer reads directly in any unit desired, and is non-cyclical in operation, employing the time-proved disc-and-wheel integrating principle, and is automatically corrected for any belt speed variations.

V Soot Remover. A new liquid fuel oil treatment called Elraco Soot and Sludge Remover is reported to clean the entire fuel system from storage tank to burner tip and reduce the fireside cleaning to a matter of ordinary brushing or blowing. Added to fuel oil in the ratio of

IS IT HOT ENOUGH FOR YOU?



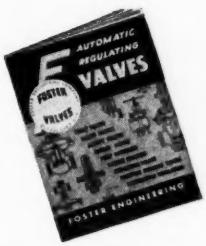
HEATING will be no problem this winter for a large electrical manufacturer who has already installed an 8 inch Foster Type J-2 double seated pressure regulator. It reduces the continuous flow from an intermediate pressure of 65 pounds to heating pressure of 5 pounds. Note that the pilot return line is large—good power plant practice at any time, but especially so when quick response and accurate regulation are required.

Eventually, somebody may figure out a practical way to store up excess summer heat for use in winter.

Until then, it looks as though we'd have to rely on the heating systems we have now, which means that they have to be dusted off and put in shape for another season or two. The logical time to check and overhaul the heating system is when it is shut down . . . in the summertime.

It's the time for *you*, because it is easier to *prevent* trouble than to take care of it as an emergency. No "cold" days for the plant with "hot", all-night repair jobs . . . no temporary makeshifts to be replaced later on.

It's the time for *US*, because we can go over your requirements with you, see that you get exactly what you need from the complete Foster line, and get the necessary regulators or parts . . . from stock . . . in time to be installed before that first call for heat.



DON'T MISS these two helps — the Foster Representative and the Foster Catalog. Foster reps are trained and qualified to see that you get the proper regulator—the catalog is extremely useful in planning because it gives specifications on the various Foster valves. A 3c stamp is all it takes to tell us you want one or BOTH.

FOSTER ENGINEERING Company

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . AUTOMATIC STOP AND CHECK VALVES . . . ALTITUDE VALVES . . . DAMPER REGULATORS . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . LIQUID LEVEL CONTROLLERS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN AND TRIPLE DUTY VALVES . . . VACUUM REGULATORS OR BREAKERS . . . SIGHT FLOW BOXES . . . STRAINERS . . . SAFETY VALVES . . . SIRENS

111 MONROE STREET • NEWARK 1, N. J.

1 quart to 1000 gallons of fuel oil, this treatment starts immediately to dissolve sludge and to emulsify water and oil so that water and sludge are consumed as the fuel oil is burned. Continued use of Elraco treatment, according to the manufacturer, eliminates all manual sludge removal. In the process of burning, treated fuel oil generates a chemical gas which reduces soot to fine carbon particles which are generally carried away by the smoke or removed by brushing or blowing. When fuel oil is treated regularly, soot does not build up on the heating surfaces. This fuel oil treatment is harmless to metals and is non-corroding. Elraco Engineering Co.

W Electrode for Light Metals. A new electrode, "Hobart No. 13," designed to simplify the welding of light gauge mild steel, has been announced by Hobart Brothers Co.

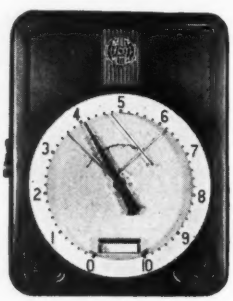
Low penetration, ease of handling and steady uniform transfer of metal all contribute to make this electrode extra fast for out of position welding on light gauge sheet metal. It is also recommended for welding light sections of mild steel to heavier ones.

This electrode is designed for use with d-c straight polarity or a-c, and is available in 1/16 in., 5/64 in., 3/32 in. and ⅛ in. diameters.

X Electronic Area Meter A new electronically-operated Area Meter developed by Bailey Meter Co. is said to accurately measure the more viscous liquids: black liquor, tar, chemicals, distillates, and refrigerants as well as freer flowing liquids: water, oil, gasoline, etc.

This flow measuring instrument consists of a specially designed telemetering transmitter connected to a standard Bailey electronic receiver. The transmitter is easily installed in the pipe line, much like a valve.

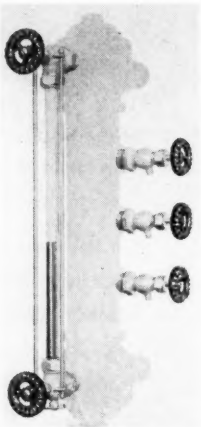
The Area Meter is said to have several advantages: its installation is simplified as the recorder is constructed of packaged electronic components which do not need to be carefully leveled and are not affected by vibration; the recorder may be calibrated to read in terms of volumetric units thereby reducing errors due to density changes; two transmitters may be connected to the same recorder to measure the ratio, sum or difference of two flows.



The transmitter has a port area varied by a plug restrained with a calibrating weight or spring. The plug assumes a position proportional to the rate of flow. This results in a substantially constant pressure drop: usually 2 psi if a weight is used for calibration or 10 psi if a spring is used.

The plug is directly connected to the soft iron core of the telemeter transmitter and any movement of the plug causes a voltage ratio variation in the telemeter circuit. This variation is transmitted to the receiver, which may be an indicator, recorder and/or controller. The electronic receiver employs an impedance bridge measuring circuit which is extremely sensitive to any unbalance in voltage ratio and therefore reacts to the slightest movement of the plug.

Y HP Boiler Fittings High-pressure water gages and gage cocks can now be shipped promptly according to an anouncement from



the manufacturer, Swift Lubricator Co., Inc. These gages and cocks are standard equipment on many leading makes of high-pressure boilers. Maximum working pressures are marked on each fitting as required by boiler codes.

The No. 160 Water Gage and No. 196 Gage Cock are available in ⅜ in. ½ in., and ¾ in. iron pipe thread sizes. The gages have self-cleaning stems and are complete with packing and any length gage glass and guards. The cocks are also shipped complete with packed stuffing box; the soft metal seat is a special alloy that gives positive, long-life shut-off and will not squeeze out in service.

Z Thermostatic Traps Sarco Company, Inc. is now making cast-steel thermostatic steam traps with the patented helical bellows to satisfy the field demands for traps which will: a. withstand the shock of external explosions, such as occur in oil refineries and chemical plants; b. handle corrosive condensate, and; c. operate with pressures to 300 psi or with superheat.

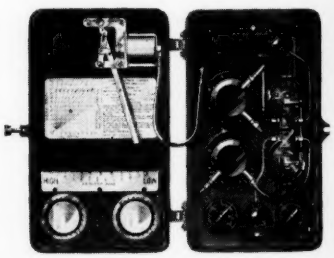
The cast-steel body and cap provide the strength necessary to withstand the shocks of external explosion.

The stainless steel thermostatic element safely handles corrosive condensate and permits these traps to be used for superheat or for a maximum operating pressure to 300 psi. Another of this series has a bronze thermostatic element for maximum operating pressures to 225 psi saturated steam.

The trap will handle pressure changes or fluctuations because the differential between the pressure created in the thermostatic bellows and the steam pressure remains practically constant. When installed to discharge to the atmosphere, no protections is required against freezing. For capacities, diagrams and prices, write for Bulletin No. P. R. 1176.

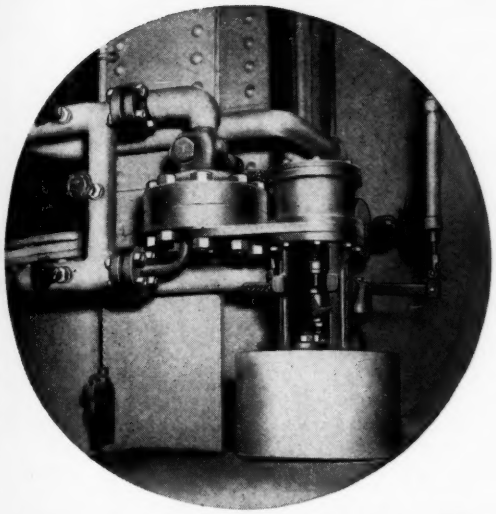
AA Dual Pilot Level-Trol Many operations in process industries, such as petroleum, chemical, and power generation, have applications where it is desirable and necessary to indicate as well as control the level in an accumulator, pressure vessel or heater. In many applications it may also be desirable to record liquid levels.

In such applications, the indication or recording of level is often better separated from the controlling function by a separate transmitting unit so that the operator may change his lever control point, or range of level operation without disturbing his indications or records of level. When one



controller serves both functions there is always the possibility that a change in level setting or change in proportional band might be made which would throw the level indicator or recorder, located at a remote point, out of calibration and give false information to the operator who would be relying on his level indication at the control house. Such an occurrence might cause a vessel to overflow—or run dry—with resultant upset and damage to a continuous process operation.

The Fisher Governor Co's Series 2406-248 Level-Trol, which has two distinct pilot circuits, offers a solution to this difficulty. The unit can be installed and the indicator portion set to indicate or record level over the full float range and then locked in position. The control function is handled by the second pilot, which pilot may be adjusted by the operator without danger of disturbing indication or recording of level within the vessel upon which the unit is located.



675 psi. This unit produced chart below. Report 463.

For rising water level on an increasing boiler load

If you prefer a slightly higher water level on heavy boiler loads than on light, as in the charts below, install COPES Flowmatic Control. If you want a practically-constant level for all loads or a lowering level on falling loads, this modern two element control system—individually designed for your operating conditions and preferences—will provide it. Backed by over 2000 installations at pressures up to 1825 psi. Write for data.

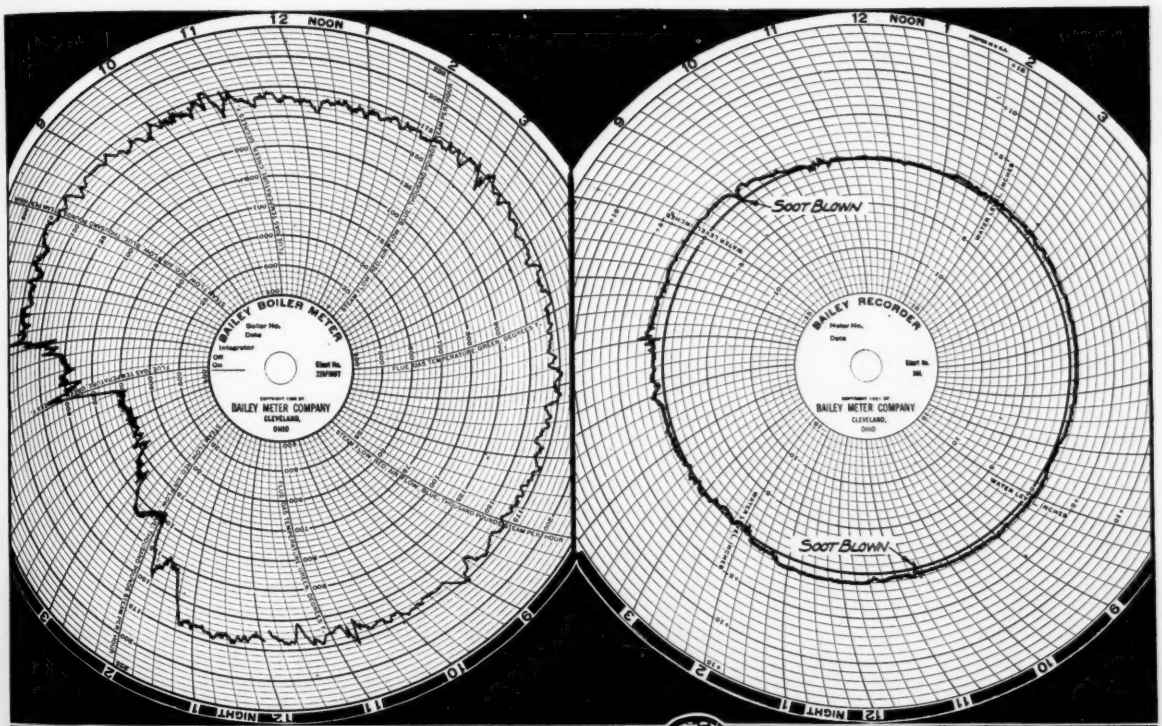
NORTHERN EQUIPMENT COMPANY

972 GROVE DRIVE, ERIE, PENNSYLVANIA

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS: Canada, England, France, Austria

Representatives Everywhere

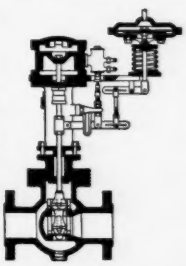


★ *Get Closer Level Control With The* COPES FLOWMATIC

AIR-OPERATED REMOTE CONTROL

Permits absolute flexibility of installation for COPES Feed Water Regulators of either simple-level-control or two-element Flowmatic type. COPES transfer switch and control panel illustrated provides remote positioning of feed valve from boiler operating board or any other desired point. Air is used as the operating medium. Dependable performance is demonstrated daily in many COPES-equipped high-duty steam generating stations.

PRESSURE REDUCING VALVES



Ideal for those applications where results not attainable with "stock" valves are desired. There are eight types, direct-and relay-operated, from which COPES engineers select the one best suited to demands of the individual installation, then design ports and pressure range for the specified conditions. Low friction, accurate balance and ample power. Available as single units or for multiple installations. COPES Master Control permits remote operation.

SMALL TRAP

BIG *Performance*

Little? Sure. But what a giant's job they do:

That's how men judge Yarway Impulse Steam Traps.

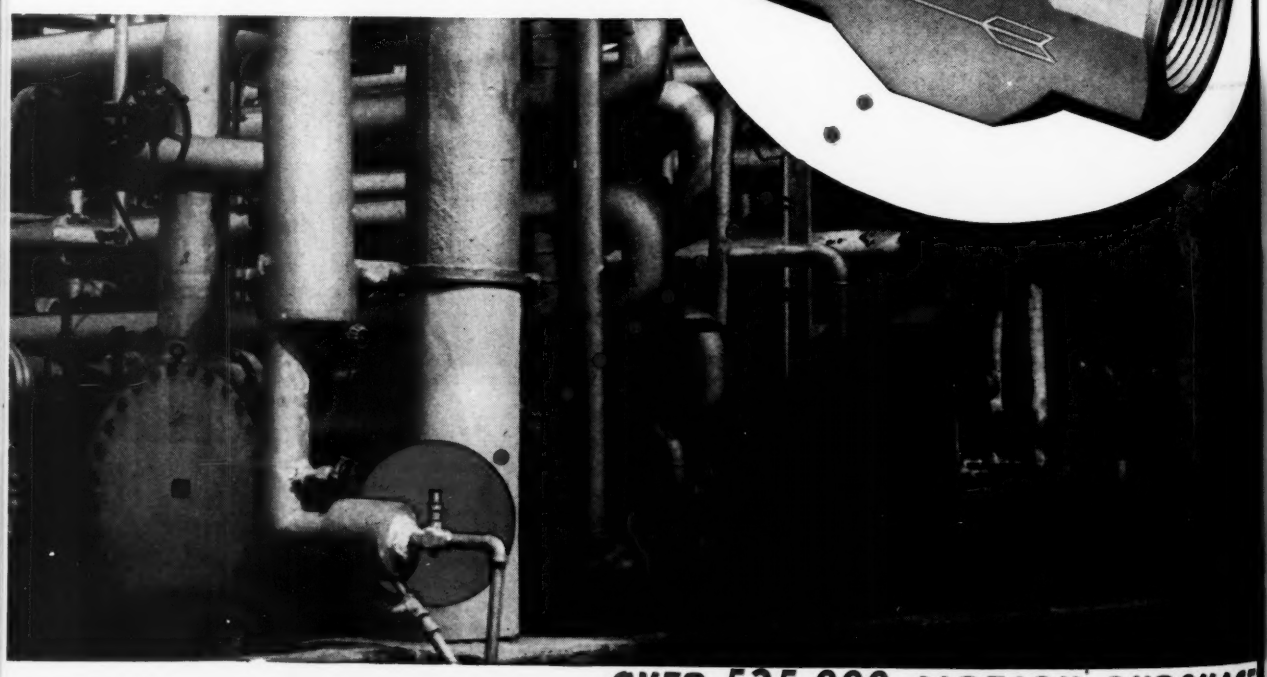
Yarways are well suited for trap service throughout industry. The small size itself is an important feature. They are easy to install, fit in anywhere, require no special supports.

In service they *drink* condensate, discharging *continuously* on heavy loads, at short *intervals* on light loads—providing maximum heat in the shortest time, and keeping equipment at top efficiency.

Yarways are suitable for all pressures without change of valve or seat. Simplicity of construction (only one moving part) minimizes maintenance. Also, initial cost is low.

Try some Yarways today—standardize on them tomorrow. See your nearest Supply House or write for Yarway Bulletin T-1739.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.



OVER 525,000 ALREADY PURCHASE

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Electric Power and National Defense

By JOHN W. SWAREN

THREE TIMES within the memory of men still living has this nation of ours developed a defense mechanism, an industrial mobilization without equal—and three times has this disintegrated, leaving behind little on which could be built the structure of another defense. And a most important material of that structure is the electric power industry. The pattern has been that the expansions from impact of national emergency, or war, could not have been, nor in the future, could not be, achieved without that ubiquitous reservoir, the public utility industry of electric power.

What constitutes successful war? The essentials may be analyzed as: Mobility; Striking Power; Coordination.

Students of the Industrial College are concerned primarily with the second element — striking power—as exemplified by welding into unity the industrial might of the nation, whereby withering blows can be struck against the enemies of the nation by the mobility and foot work of its tacticians, directed by "one-two" coordination of its staffs. This pattern has been fundamental through the ages.

Will it continue?

In detail it varied little until the Industrial Revolution. However, war has modified industrial technic as much as industry has modified war—perhaps more. The necessity for speed—and an assured supply—in arming troops of the American Revolution, was the first real implementation of the theory of interchangeable parts in manufacturing. The French Revolution saw developed a true assembly line for production of muskets. Minor wars in Italy first saw effective use of rail transportation for troop movement and supply. In the great conflict between our states, rail transportation became a major tool of strategy and tactics. From the lessons there learned, came the design of the framework on which strategy of nations is based.

Spanish Revolution Lesson Unheeded

The industrial changes you have witnessed in the last half decade were not without prototypes. So wars have their prototypes. The lesson and classroom of rail transportation has been mentioned. So the Balkan wars were schoolroom and pilot plant for 1914-1918. And 1939-1945 had a forerunner in a little understood war, a war the military lessons of which were plain,—**and unheeded industrially.** Lessons which yet may work profound changes in the electric power industry. I speak of the Spanish Revolution.

As modern wars are measured, it was not a large war. But it was isolated. Its tactical lessons were not distorted by territorial constrictions. But it has not received merited study because even few professional soldiers can escape its ideological implications. However, relationship of the power industry to the entire conflict can be isolated without reference to ideology, so let us examine the geography and operational terrain involved.

Spanish Industrial and Electrical Development

The Iberian Peninsula is a rectangular block of land suspended from the southwest corner of Europe by a wide, but very mountainous isthmus. Transport to the rest of Europe is confined to defiles on either side of the isthmus, and a few not too good harbors. As a result, Spain has always been one of the most self-sufficient of countries; although measured by standards of other nations its scale of living has been low in the industrial era. It lacks fuel, having only a small amount of very low grade coal. Other minerals and metals are present in reasonable amounts. In the northwestern corner, along the shores of the Bay of Biscay, and among the Cantabrician foothills a steel industry has grown—based on imported coke.

Long before recorded history Spain was husbanding water resources for irrigation. Much of our own water law stems from practices transferred to our semi-arid regions. When transfer of energy by electricity came, Spanish engineers were early in utilizing the limited sites of the Cantabrica and the Pyrenees. Steel and heavy industry now grew beyond the meager national requirements but was still tied to the Biscayan region. But in the northeast, in the Catalonian area, an industrial zone of end production grew. A third industrial area lay in the southwest, based on copper. These areas were the major industrial support of both factions.

Contrary to popular belief, neither faction received important quantities of military material from outside sources. Most of this foreign support was pilot plant operation, pure and simple, with organized forces sent by foreign powers. These held aloof from the Spanish troops—and except for higher echelons kept results within their own confidences. The lessons taught by these experiences bore much fruit in Germany and Russia—less, perhaps none, in other countries.

But another lesson—in my estimation, the most important lesson of this war—went unheeded by all the general staffs—of Europe and Asia and America. That was the lesson of electric power. Our enemies will

(Continued on page 146)

John W. Swaren, Research Analyst, Industrial College of the Armed Forces, Washington, D. C., here issues a warning to the nation that must not go unheeded. His experiences include special work with the Western and General Electric companies in electric power and experimental laboratory work. He was engineer of tests for the Pacific Gas and Electric Co., 1901-04, and contract manager for the Nevada Machinery and Supply Co., 1905-08, supervising construction of pumping plants and municipal water works. From 1909 to 1922 he practiced as a consulting engineer, except for the war years, 1917-19, when he served in France as Captain and Major of Engineers.

In 1922-23 he was appraisal engineer for the Bureau of Internal Revenue, making postwar evaluations of war plants. He continued this work on a consulting basis in Cleveland, 1923-27 As engineer with the National Defense Power Committee preceding and during World War II he made analyses of electric power and other utilities operations, and recommendations regarding requirements of large industrial plants in transferring from peacetime to war activities.

For the past two years Mr. Swaren has been a member of the research staff of The Industrial College of the Armed Forces, specializing in the field of electric power. At present he is on detached service in the Orient, engaged in surveying the task of rehabilitating central power plants. The above material is taken from his paper before the Midwest Power Conference, April 2, 1947. The views expressed are his own and are not intended to reflect the policy of the Industrial College of the Armed Forces.

Champion-International Adds 70,000-lb-per-hr Boiler

By L. B. ROGERS, *Vice-President, Champion-International Co., Lawrence, Mass.*

As told to CHESTER R. EARLE, *Associate Editor, Power Plant Engineering*

ANOTHER STEP in the expansion of its power plant, to keep abreast of today's demands, has been taken by Champion-International Co. of Lawrence, Mass., manufacturer of the paper on which *The National Geographic* magazine is printed. This further step consists in the installation of a new steam generating unit, which will insure a dependable steam supply for the paper mill, increase flexibility of fuel purchasing and take advantage of the improved efficiency obtainable from standard present-day equipment. The new unit, designed to meet these requirements, consists of a 70,000-lb-per-hr steam generating unit, as shown in the illustrations, equipped for firing by pulverized coal or oil, and generating steam at 400 psi.

The latest step in the Champion-International power plant program is primarily a process of replacing existing steam generating capacity with new, to secure the advantages listed above. At the same time, certain changes are being made in the pulp mill digesters to increase their efficiency and new digester capacity is being added. However, these changes will increase the steam demand only a slight amount, because of the higher utilization efficiency. The same is true of other mill demands for steam and electricity. Hence there is little heat balance modification as a result of installation of the new unit.

Power Plant Development Has Followed Carefully-Devised Policy

Before giving details of this new steam generating unit, it may clarify them to review briefly the course taken by Champion-International Co. in developing its power plant according to a carefully devised policy. This policy was described in considerable detail in an article "A Policy for Power Plant Development" by Marcus K. Bryan, in the October 1, 1931, issue of POWER PLANT ENGINEERING. A previous article, "Champion-International Co. Served by Steam and Hydro Plants," in the February 15, 1930, issue, had given details of the equipment.

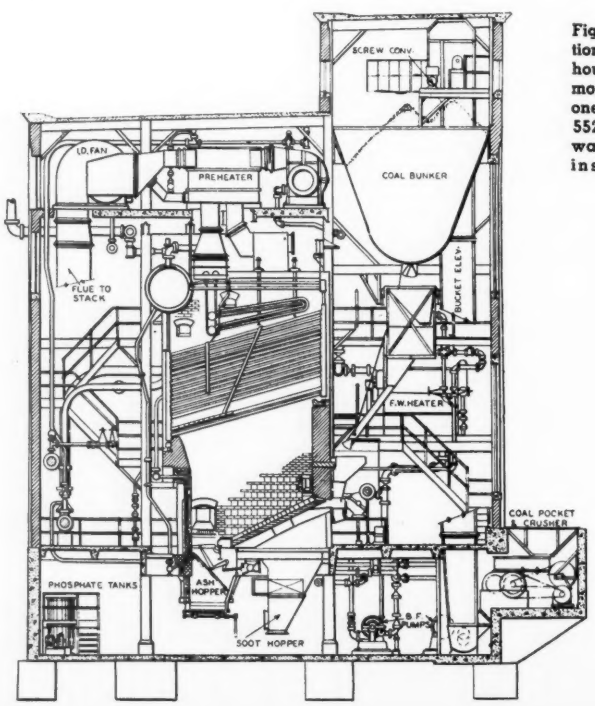


Fig. 1. Cross-section through boiler house after 1929 remodeling, showing one of two 400-psi 552-hp stoker-fired water-tube boilers installed at that time

The policy and development program were carried out under the direction of the author, at that time chief engineer of Champion-International Co., and of Marcus K. Bryan of Chas. T. Main, Inc., consulting engineers. As described by Mr. Bryan in the above article, an analysis of the power plant was made in 1928 with the object of reducing costs and providing for increased steam and power needs arising from contemplated paper mill changes. At that time, steam was generated by six HRT boilers, hand fired with coal, supplying steam to two non-condensing engines driving line-shafting and two small generators, and to a condensing turbine generator. Power was also generated by two water-wheel generating units. All coal and ashes were handled manually.

Analysis of the existing heat balance did not show any wastes worth recovering, although the operating expense was higher than the modern industrial plant practice of 1929. Accordingly, data collected in studying the existing conditions were analyzed, estimates made of the power and steam requirements after mill changes and three plans for rehabilitating the power plant were worked out. In doing this, the engineers considered the effect of changes on the existing equipment and figured its abandonment only on the basis that new equipment would produce worthwhile earnings.

How the 1928-29 Program was Carried Out

As finally developed and put into effect in 1929, the following program was adopted:

The boiler plant was remodeled by installing two 400-psi water-tube boilers, fired by multiple-retort underfeed stokers, and equipped with superheaters and air preheaters. The new boilers occupied the space of four old HRT units, leaving two HRT units in place for standby to supply steam to the 150-psi process steam system. Coal handling equipment was also installed.

(2) One of the steam engines was replaced by a new 2500-kw non-condensing extraction steam turbine generator. This turbine generator had capacity to generate practically all the power, also to supply extraction

New 70,000-lb-per-hour steam generating unit, fired by pulverized-coal or oil, insures dependable steam supply, increases flexibility of fuel purchasing, gives advantage of improved efficiency available from standard present-day equipment . . . Installed in plant remodeled in 1928-1929, reflects 17 years' progress in boiler and firing equipment design . . . Slight increase in steam demand, pulp mill digesters being added . . . New unit to carry bulk of load . . . Auxiliaries include dust collector, continuous blow-down system . . . Present boiler house extended as planned in 1928 to house new unit . . . Feedwater supply from existing treatment and pumping system . . . No changes in turbines or plant heat balance . . . New unit takes over load, leaving 1928-1929 units for standby . . . Existing coal handling system has been extended by ingenious use of continuous flow conveyor

steam at 110 psi to processes and exhaust steam at 10 psi to coating mill and paper machines. The existing 150-psi, 1000-kw condensing turbine generator was moved to a new location alongside the new machine, and was fitted with extraction gear so it could supply 10-psi steam to the low pressure steam system.

The plan was carried out in steps. All new equipment was ordered for 400 psi. But the boilers were installed first and operated at 150 psi with low superheat, until the new 2500-kw 400-psi turbine generator could be installed. Meanwhile the old 1000-kw turbine generator in its new location, taking 150-psi steam, operated along with one of the steam engines and the hydroelectric plant to supply power to the mill. After the new turbine generator was installed, boiler steam pressure was raised and the second steam engine was abandoned.

This program was successfully completed in 1931 and resulted in a modern and economical power plant that has served the paper mill since that time.

The Plant as It Stood in 1931

Full details of the plant as it finally appeared in 1930 and 1931 after the above development program was worked out were given in the two articles cited above. The plant contained two new 552-hp stoker-fired water-tube boilers with two HRT's for standby; one 1000-kw and one 2500-kw steam turbine generator, supplying low pressure and exhaust steam to processes, plus electricity; and two hydraulic turbine generators of 1000 kw and 500 kw capacity, respectively, also supplying electricity.

An interesting feature of this plant was a special recorder and control for regulating the water-wheel gate opening in order to replace hydro power with steam power at lower cost. The 2500-kw turbine runs on speed control and the variations in low-pressure process steam supply and demand are coordinated by governing the water wheel gate openings from the pressure on the low-pressure steam system. This gives better control to the system, as compared with control from the water wheels.

Another interesting feature of the plant in 1930 was the installation in the new boiler room of a waste heat

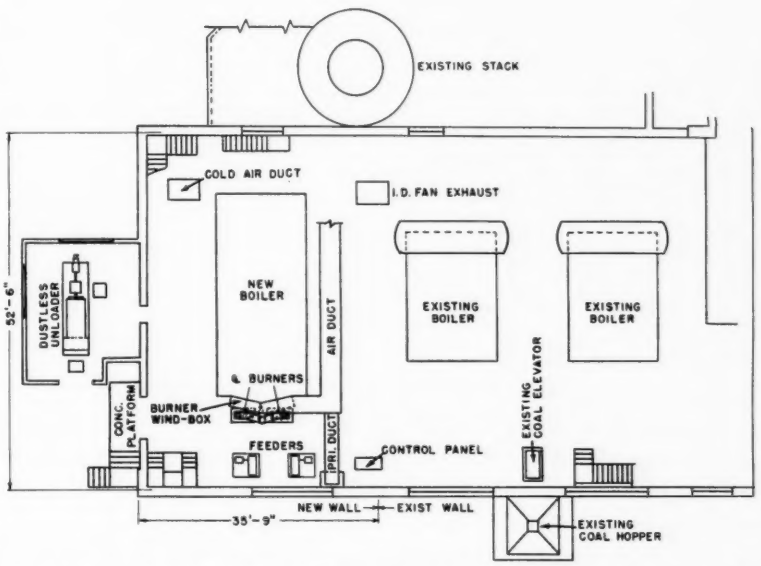


Fig. 2. General plan of 1947 boiler house extension showing new unit alongside two older ones

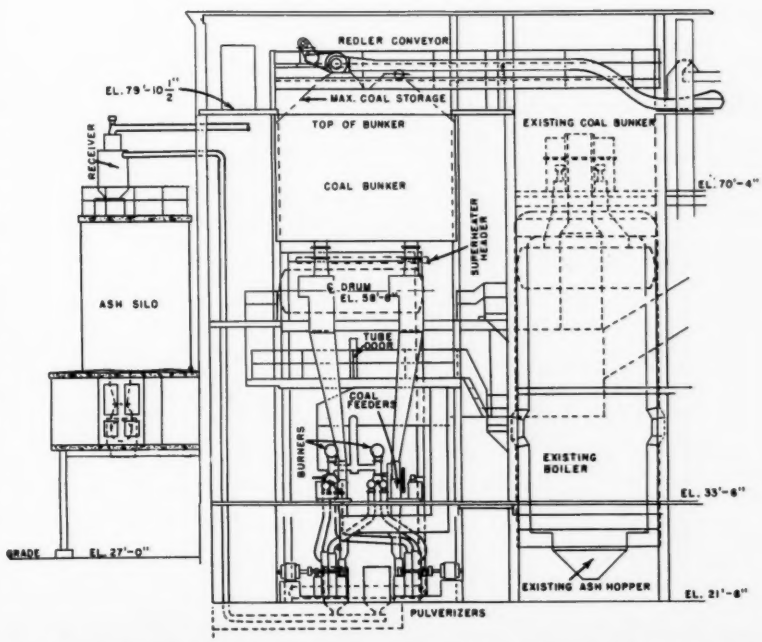


Fig. 3. Longitudinal section through boiler house extension, showing front view of new unit and arrangement of coal and ash-handling equipment and coal pulverizers

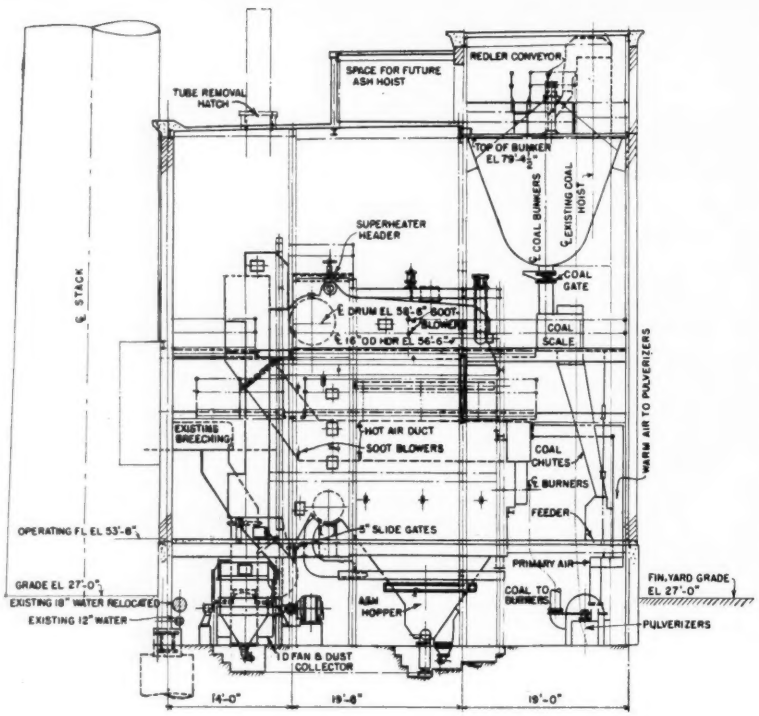


Fig. 4. Cross section through boiler house extension, showing side view of new 1947 unit and auxiliaries

economizer to recover waste heat from the gases of the soda recovery process in the paper mill. Water from the deaerating heater is pumped through this economizer, where its temperature is raised to 275 F before it enters the boilers. This economizer is still in use, depending on the operations of black ash burning in the soda mill in the following way.

In this soda mill, a new soda recovery unit was installed in 1939. This included a waste heat boiler generating steam at 400 psi, which is supplied to the 400-psi steam system in parallel with that from the 400-psi coal burning boilers. With increased soda pulp production, both soda recovery furnaces will operate continuously—the 1930 installation with the economizer, as described above, for feedwater heating; the 1939 installation generating steam at 400 psi.

Savings expected as a result of the new power plant in 1929 were realized. Steam turbine operation alone reduced the cost of water about $20,000 a year. The coal saving in dollars was in greater proportion than in tonnage because the stokers could burn lower priced coal.

The New 1947 Boiler Installation

In installing the 1947 unit, no attempt has been made to evaluate the unit in the same terms as the old ones, either as to carrying the loads or as to dollar savings. There have

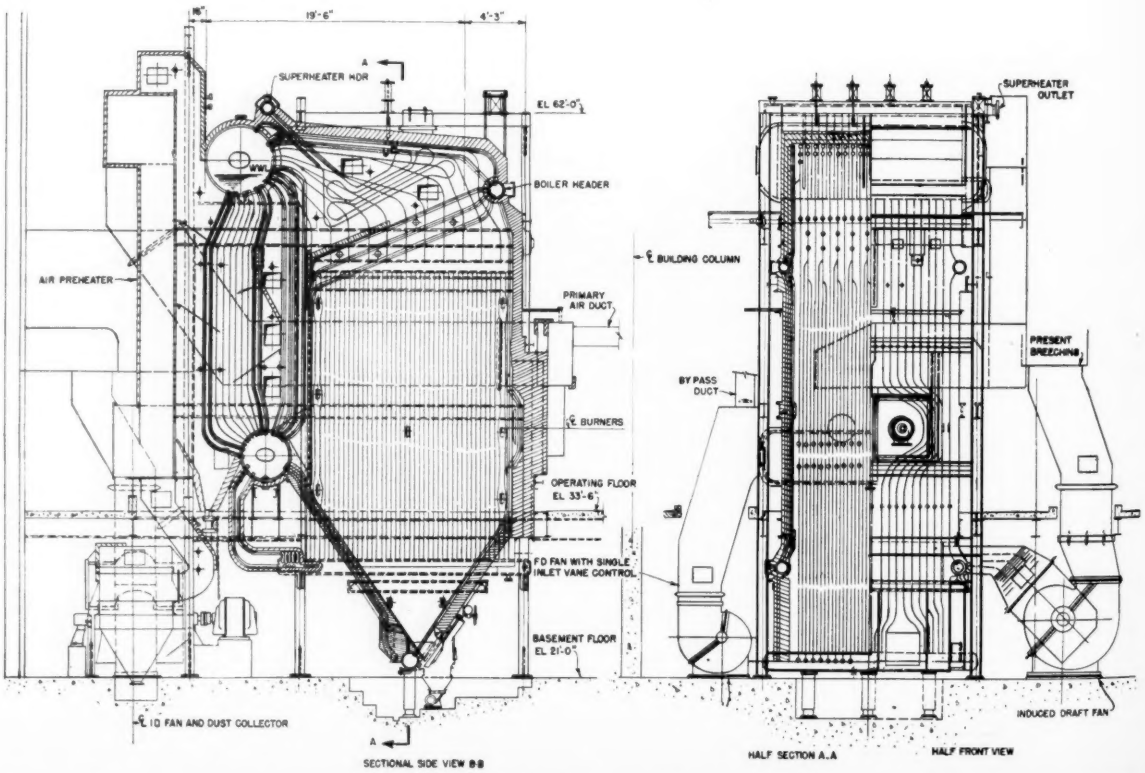


Fig. 5. Cross-sections through new 70,000-lb-per-hr pulverized-coal-and-oil-fired boiler installed in 1947 boiler house extension

been no changes in the turbines and only slight modifications in the load quantities.

The new boiler will carry most of the load and all of it at certain times of the year. Not more than one of the present boilers will be in service along with the new boiler. No evaluation in dollars and cents has been attempted of improved efficiency and greater flexibility in both load carrying capacity and fuel range. Overall operating cost savings cannot be stated at this time.

The new boiler is shown in Fig. 5 and described in detail in the list of equipment, page 72. It is of standard Riley construction, as shown, and needs little description. Its relation to the two existing boilers and auxiliaries is shown in Figs. 2, 3, and 7.

Coal and Ash Handling

Coal for the existing boiler plant has been delivered in railroad cars, entering the plant property on tracks adjacent to the boiler house. Coal could be unloaded from the cars by means of a traveling crane or hopper and fed through a crusher to a bucket elevator, which transported it to overhead steel bunkers, all as shown in Fig. 1. This coal handling system has been extended to serve the new boiler, as shown in Fig. 3. It was not feasible to attempt to extend the existing bunker, because of construction and steelwork problems. So a new section of bunker was built for the new boiler. To load coal into this bunker, a continuous flow conveyor was installed as shown. The existing bucket elevator thus can deliver coal to the right, Fig. 3, for either of the existing boiler bunkers; or to the left, by

Table I. Performance data for 70,000-lb-per-hr 400-psi 625 F boiler, Champion-International Co. for two types of coal and three rates of output

PERFORMANCE DATA—One (1) steam generating unit, 70,000 lb of steam per hour maximum continuous capacity; 400 lb gage operating pressure; 230 F feedwater; steam temperature 625 F. Fuel—BITUMINOUS COAL "A", Moist. 4.0; V. M. 34.0; F. C. 52.5; Ash 7.5; Btu as fired 13,800; H 4.8; ash softening temperature 2200 F. COAL "B", Moist. 3.0; V. M. 24.92; F. C. 64.08; Ash 8.0; Btu as fired 13,850; H 4.63; ash softening temperature 2400 F.

	Coal "A"		Coal "B"
1. Pounds of steam per hour actual evaporation	45,000	60,000	70,000
2. M.Btu in steam above feedwater temperature	50,600	67,500	78,600
3. Developed boiler horsepower	1,510	2,020	2,350
4. Temperature of gases leaving furnace, deg F		1,890	2,000
5. CO_2 in boiler exit gases	14.5	15.0	15.0
6. Per cent excess air in boiler exit gases	26	22	22
7. Temperature of boiler exit gases, deg F	560	595	620
8. CO_2 in air heater exit gases	14.5	14.5	14.5
9. Temperature of air heater exit gases, deg F	350	370	385
10. Temperature of air entering heater (room temp) deg F	80	80	80
11. Temperature of air leaving heater, deg F	365	380	395
12. Total steam temperature leaving superheater, deg F	610	618	625
13. Steam pressure drop thru superheater, lb per sq in.	6	10	13
14. Boiler Drum pressure, lb per sq in.	396	400	403
15. Draft loss thru boiler and superheater	0.83	1.48	2.00
16. Draft loss thru air heater	0.92	1.62	2.20
17. Draft loss thru dust collector	1.03	1.83	2.50
18. Draft loss thru ducts and dampers	0.22	0.37	0.50
19. Furnace draft	0.10	0.10	0.10
20. Total static suction at fan, inches water gage	3.20	5.40	7.30
21. Air pressure drop thru air heater	1.2	2.2	3.0
22. Air pressure drop thru ducts and dampers	0.2	0.4	0.6
23. Air pressure in burner boxes	0.7	1.2	1.8
24. Total static pressure at fan, inches water gage	2.1	3.8	5.4
25. Pounds of fuel per hour	4,250	5,700	6,650
26. Pounds of air per hour	54,000	71,000	82,500
27. Pounds of gas per hour leaving heater	58,000	78,000	91,000
28. Overall efficiency complete unit	86.0	85.4	85.2
29. Heat release in furnace, Btu per cu ft per hour	15,900	21,300	24,800
HEAT BALANCE			
30. Dry flue gas loss at exit	6.13	6.60	6.98
31. Loss due to hydrogen and fuel moisture at exit	3.97	4.00	3.76
32. Loss due to moisture in fuel at exit	0.15	0.16	0.16
33. Loss due to radiation	1.25	0.94	0.80
43. Loss due to unburned combustibles	1.00	1.40	1.60
35. Unaccounted for and leeway	1.50	1.50	1.50
36. Total losses	14.00	14.60	14.80
37. Efficiency of complete unit	86.0	85.4	85.2

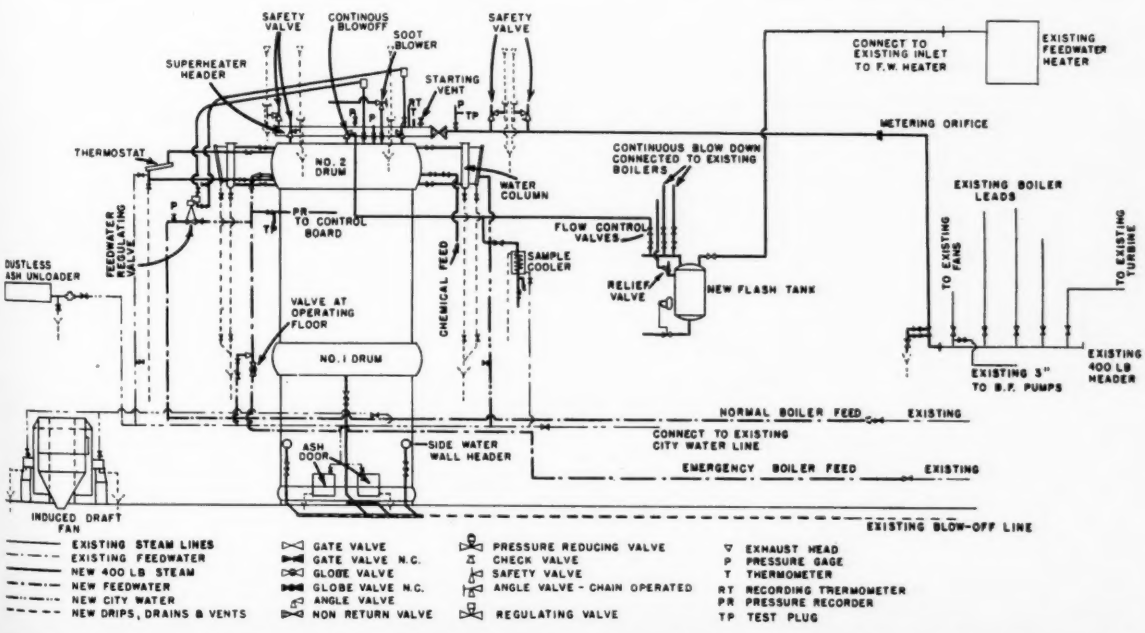
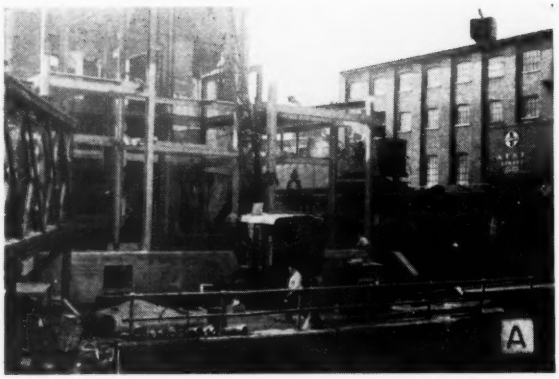
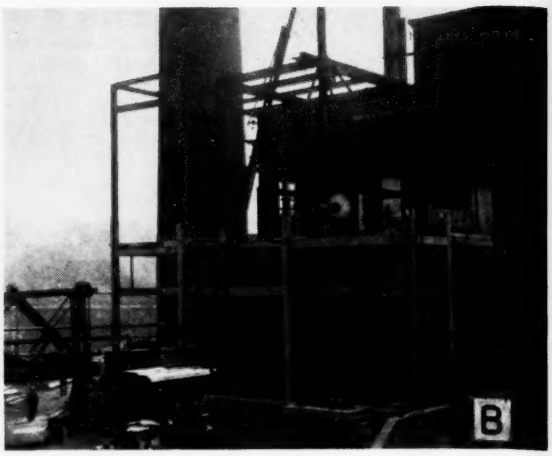


Fig. 6. Flow diagram showing new steam, feedwater and auxiliary piping for new 70,000-lb-per-hr boiler. Connections are made to existing water system, which was originally designed with adequate deaerating heater and pumping capacity. The new boiler's capacity replaces old capacity for much of the time, hence existing water treatment system had necessary capacity





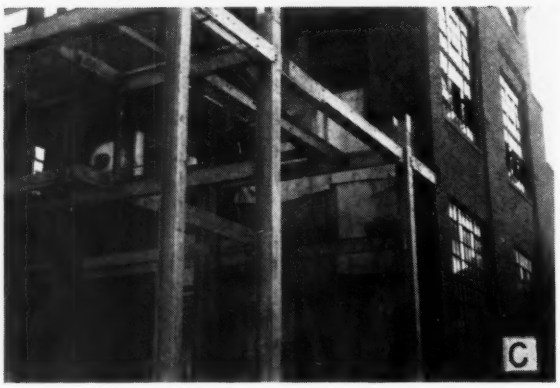


Fig. 7. Three views of Champion-International boiler house extension during construction in late 1946

A—General view showing steelwork erection. On bridge at left, process steam headers and electrical cables cross river to paper mill buildings

B—General view of steelwork for extension, showing relation of new boiler to existing brick chimney and to boiler in existing boiler house

C—Close-up showing how steelwork for extension was joined in existing boiler house steel. Drum of one existing boiler in background

means of the continuous-flow conveyor, for the new unit.

A pneumatic ash conveyor system has been installed, as in Fig. 3. Provision has also been made for a skip hoist to handle ash from the existing boilers, so it can be delivered to the ash silo for further disposal.

The draft equipment for the new boiler is as shown in Figs. 4 and 5. Two-speed fans with vane and damper control are employed and the performance expected of the fans is shown in Table II. The induced draft fan discharges to the existing boiler breeching, which connected with an existing red brick chimney 8 ft in diameter at the top by 175 ft high above grade. This chimney provided natural draft for the original six HRT boilers; now, with mechanical draft, its primary duty is to discharge flue gas high in the air.

Feedwater for the new boiler will be supplied by the existing feedwater treatment and pumping system, since the existing boilers will be shut down

LIST OF PRINCIPAL EQUIPMENT 1947 STEAM GENERATING UNIT, 70,000 lb per hr, 450 psi, 625 F Champion-International Co. Lawrence, Mass.

Steam Generating Unit (1)
Riley Stoker Corp.
Boiler, designed for maximum continuous steam generating capacity. 70,000 lb per hr. Design steam pressure 450 psi 625 F. Operating pressure 400 psi, 625 F. Boiler heating surface 6685 sq ft, furnace water wall heating surface, 2625 sq ft; furnace volume 3700 cu ft. Superheater surface to provide 625 F total steam temperature.

Air Preheater (1).....Riley Stoker Corp.
Tubular type, heating surface 6600 sq ft. Designed to heat air to 395 F at 70,000 lb per hr steam output, reducing air preheater exit gas temperature to 385 F. Air and flue gas temperatures at other outputs as shown in Table I.

Coal Pulverizers (2)....Riley Stoker Corp.
Type No. 4 pulverizers, maximum capacity each 5000 lb coal per hr. Drive, General Electric Co. 60-hp, 1175-rpm motor. Self-cleaning drum-type pulverizer feeders located on operating floor, each driven by G. E. Co., ¾-hp motor.

Burners (2).....Riley Stoker Corp.
Flare type No. 3 burners, with capacity of 5000 lb coal per hr each. Equipped with Engineer Co. oil burners for alternate firing by oil.

Fuel data, performance data and boiler heat balance data given in Table I. Designed fan performance shown in Table II.

Forced Draft Fan (1)
Green Fuel Economizer Co.
Type RF, No. 34, Design 3908-SV4 fan, single-width, single inlet, inlet vane control. Fan driven by G. E. Co., 40 hp, 1800-1200-rpm, 2-speed motor.

Induced Draft Fan (1)
Green Fuel Economizer Co.
Type RR, No. 46, Design 3701-V5 fan, double-width, double inlet with outlet damper and inlet vane control. Fan driven by G. E. Co. 100-hp, 1200/720-rpm, 2-speed motor.

Automatic Combustion Control
Bailey Meter Co.

Boiler Control Panel .... Bailey Meter Co.
Carrying following instruments:
6-point Draft Gage, measuring:
Forced Draft Air Pressure
Windbox Pressure
Furnace Draft
Boiler Outlet Draft
Air Heater Outlet Draft
Pulverizer Suction
Steam-flow Air-flow Meter
Steam & Feedwater Pressure Recorder
3-point Temperature Recorder, measuring:
Boiler Outlet Gas Temperature
Air Heater Outlet Gas Temperature
Air Heater Outlet Air Temperature

Complete Boiler Installation, including steelwork.....Riley Stoker Corp.

Dust Collector (1).....Prat-Daniel Corp.
Thermix tubular type.

Soot Blowers
Diamond Power Specialty Corp.

Coal Conveyor
Stephens-Adamson Mfg. Co.
Redler continuous flow type conveyor, maximum capacity 30 tons per hr, driven by G. E. Co., 5-hp motor.

Coal Bunkers (1)
Groisser & Schlager Iron Works
Suspended steel type.

Coal Scales (2).....Richardson Scale Co.
Automatic weighing.

Ash Handling Equipment
United Conveyor Corp.
Pneumatic ash-handling system, ash receiver, ash silo of tile, 12 ft diameter, 18 ft 5 in. high; Stephens Adamson duplex ash gate; provision for future skip hoist.

Steam and Water Piping
Power Piping Co.

Continuous Blowdown System
Cochrane Steam Specialty Co.

Ductwork.....Riley Stoker Corp.

Water Columns
Reliance Gauge Column Co.

Feedwater Regulator (Copes)
Northern Equipment Co.

Valves
Non-return.....Edward Valves, Inc.
Blow-off .....Yarnall-Waring Co.
Safety..Crosby Steam Gauge & Valve Co.
Pressure-Reducing and Regulating
Ruggles-Klingemann Mfg. Co.
Globe, Gate and Angle.....Crane Co.

Instruments.....Bailey Meter Co.
Pressure indicating gages, pressure recorders, thermometers, temperature recorders, draft gages, flow meters.

Consulting Engineers..Chas. T. Main, Inc.

much of the time. Boiler feedwater supply is filtered Merrimac River water, taken from the main mill supply. This water, together with all returns from processes, is delivered to an open deaerating heater of 150,000 lb per hr maximum capacity. From this it flows to the suction of two 250-gpm centrifugal boiler feed pumps. One pump is motor-driven and one is turbine driven. One of these pumps, depending on heat balance conditions, pumps the feedwater either directly to the boiler or through the waste heat economizer to the boiler.

The new piping system required for the 1947 unit is shown in Fig. 6, while the performance of the unit at three different rates of output, and for two different coals, is shown in Table I.

The design of the 1947 extension was under the personal direction of Marcus K. Bryan of Chas. T. Main, Inc., who had made the original analysis for the 1929 development program and personally supervised the design of the plant at that time. It is of interest that the original HRT boilers, which have been replaced by the 1929 and 1947 developments, were designed and installed in 1902 by Dean and Main.

Table II. Capacities and speeds of forced and induced draft fans, new 70,000-lb-per-hr boiler Champion-International Co.

FORCED DRAFT FAN	Approx. Speed Change Point			20% Max. 40%	volume static
Pounds steam per hour	55,000	60,000	70,000		
Pounds air per hour at 80 deg F	65,000	71,000	82,500	99,000	
Static pressure at fan	3.2	3.8	5.4	7.5	
Fan RPM	1,160	1,760	1,760	1,760	
HP input to fan shaft (vane control)	13	24	28	39	
INDUCED DRAFT FAN	**Approx. Speed Change Point**			**20% Max. 40%**	**volume static**
Pounds steam per hour	50,000	60,000	70,000		
Pounds gas per hour	65,000	77,000	91,000	109,000	
Gas temperature, Deg F	360	370	385	420	
Static suction at fan	3.8	5.4	7.3	10.2	
Fan RPM	690	1,170	1,170	1,170	
HP input to fan shaft (vane control)	22	60	70	97	

Russia Burns Peat for Power —It May Aid U. S. Iron Ore Production

DISCOVERY that Russia is processing from 50 to 60 million tons of bog peat into gas and power to serve industrial needs has quickened America's 60-year-old but relatively dormant efforts to utilize the country's nearly 14,000,000,000 tons of this low-grade fuel.

This was disclosed at the Annual Convention of the ASCE by Robert L. Fitzgerald, vice-president and general manager, Duluth Steam Corp. He called development of peat as an industrial fuel a "Challenge to the best talents in the engineering profession" and a matter of "first importance to the national security."

Emphasizing that detailed information on the Russian operations is far from complete, Mr. Fitzgerald asserted "some important facts about their use of peat seem to be reliably established." He then listed the following:

"They have eliminated the inherently high peat transportation costs by converting the peat into electric power and fuel gas at the site of the bog and transmitting the end products to the points of consumption.

"They are operating power stations up to 200,000 kw capacity exclusively on peat fuel, and "they are continuing to expand the use of peat as fuel in large power generating stations.

"They have reduced production man-hours from 75 to 80 per cent by introducing hydraulic and mechanical material handling methods.

"They consider their peat bogs as large reservoirs of a wide variety of chemical products, and they keep a staff of three hundred research scientists studying methods for recovering the chemicals on a commercial scale.

"Half this nation's peat deposits are in Northern Minnesota, adjacent to the state's famed iron ranges, Mr. Fitzgerald declared, and "the prompt development of practical, economic methods to make these huge, local, potential fuel deposits available to adjacent industry is not only important to the economic welfare of this state and to the basic steel industry of the nation, but it is of first importance to the national security. Iron is the item of first importance in every war.

Mr. Fitzgerald emphasized that "fuel is a prominent cost item in drilling, mining, grinding, roasting, magnetic separating and sintering." The total cost of the 1,250,000 tons of coal required for producing up to 10,000,000 tons of concentrated ore per year, a process, Mr. Fitzgerald said, now is in the advance planning stage, was estimated by the speaker at $8,750,000. To do the same job, he said, would require 2,770,000 tons of 30 per cent moisture peat, and in order to meet the coal price the peat would have to be dried to that extent at a production cost of $3.15 per ton.

"With furnace operations of this magnitude," Mr. Fitzgerald said, "it is easy to visualize sufficient waste heat to dry the peat completely to a moisture-free-condition. In this case the total quantity of peat necessary would be reduced to 2,000,000 tons and the competitive, or allowable, production cost would advance to $4.37 per ton. If such a unit cost becomes a reality, then the total cost of peat fuel to operate this project for a year becomes $4,000,000 and represents a potential saving or profit on one project of $4,750,000 per year.

Mr. Fitzgerald told the civil engineers of work in pelletizing experiments which he said, "can easily prove to be the answer to the local metallurgical use of this abundant supply of local, low-grade fuel." To date, the experiments have demonstrated that peat containing 85 per cent moisture can be easily formed into pellets the size of which can be controlled, Mr. Fitzgerald said.

"Additional experiments are planned," Mr. Fitzgerald said, "wherein the pulverized, magnetically concentrated ore, after beneficiation, will be mixed with the peat in the pelletizing operation. The end product will then be a pellet of convenient size, composed of a reasonably homogeneous mixture of peat fuel and finely divided high-grade ore. When such a product is fired in a proper furnace, the chemical and thermal conditions for de-oxidizing the ore are unavoidably present, the residual product on the heath of the furnace will be mostly metallic iron and will produce a shipping product of 80 to 90 per cent metallic iron, compared with the 51½ per cent natural iron content of current shipping ores and with the 63 per cent natural iron shipping product produced by sintering magnetic concentrates."

Comparing the freight costs for the various qualities of iron, Mr. Fitzgerald pointed out that the present 60,000,000 ton ore shipping year delivers 30,900,000 tons of natural ore at the furnaces, and that if the peat-fired 80 per cent natural iron becomes possible, only 38,700,000 tons will have to be shipped. He estimated freight savings of more than $37,000,000 per year.

How Coal Is Burned in the Mine to Produce Power and Synthesis Gas

Coal gasification in mines promises to relieve threat of oil and natural gas exhaustion . . . Coal could supply all hydrocarbon needs for 1500 years . . . Coal gasification in mines reported in foreign countries . . . Details of the recent experiment at the Gorgas mine in Alabama . . . Details of the Russian work in coal gasification since 1931 . . . Diagrams of both methods . . . How the coal burns underground . . . Effects of supplying air, steam, oxygen . . . Action of roof and overburden . . . In first American experiment, coal was burned clean, there was very little coke, the ashes were on the bottom . . . An important step in advancing possibilities that large coal tonnages may go into production of gas and synthetic liquid fuels

By CHESTER R. EARLE, *Associate Editor, Power Plant Engineering*

FOR SOME MONTHS engineers have been discussing a number of rumors and some facts regarding the gasification of coal in mines to produce gas for fuel or gas for conversion into liquid fuels or chemicals. The recent announcement of the U. S. Bureau of Mines, reported in the April 1947 issue of POWER PLANT ENGINEERING, told how the Bureau, in collaboration with the Alabama Power Co., has conducted the first American experiment in underground burning of coal for gasification purposes at the power company's Gorgas mine near Jasper, Alabama.

Russian and other Foreign Gasification Work

There have been rumors for a long time of successful underground coal gasification in Russia, yielding gas for steam production and processes. The Russians are also known to be gasifying large quantities of peat by treatment right at the peat bogs, using it to generate electric power and fuel gas, which are transmitted to points of use cheaper than the peat could be transported. (POWER PLANT ENGINEERING, this issue, page 73.) There are reports also that work on coal gasification underground has been done in Belgium, but these have not been confirmed. The British, too, have considered using the method, as indicated recently in reply to questions in the House of Commons.

In the United States, it is reported that one industrial chemical company has been successfully gasifying coal in the mine for several months. Another organization, Pittsburgh Consolidation Coal Co., has definitely announced plans for a pilot plant near Pittsburgh, followed by a full-size commercial plant when practicable, to gasify coal in the mine or at the mine mouth and produce heating gas and synthetic motor fuel from this gas. (See POWER PLANT ENGINEERING, August, p. 130).

There is much speculation as to the possibility of enriching coal mine gas with natural gas, of the possibilities of oxygen in coal gasification and in combustion, of mine mouth gas turbines and so on.

The Stanolind process for producing synthetic gasoline from natural gas was described in the August issue of POWER PLANT ENGINEERING; and the Hydrocol process of P. C. Keith, for which a plant is now being built in Texas, has been discussed in previous issues—January 1947 and others.

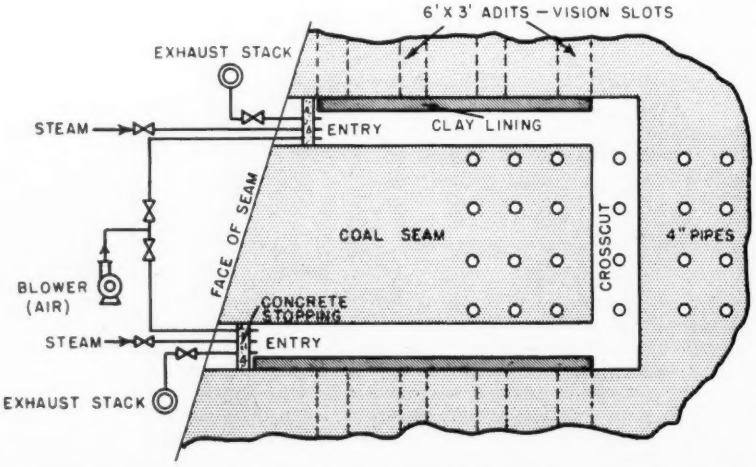


Fig. 1. Plan view of area in neck of land about 300 ft by 150 ft containing coal seam 36 in. thick, as isolated for tests at Gorgas mine of Alabama Power Co. Combustion ducts 170 ft and 140 ft long connected by 46-ft cross-cut. (Courtesy *Coal Age*)

Coal Gasification May Conserve Resources

Behind all the rumors are a number of solid facts, which will be reviewed below. If the oil and gas reserves of the United States will be exhausted in 15 to 30 years, as some insist, the situation may be saved by coal. H. J. Rose of Bituminous Coal Research, Inc. told the recent Midwest Power Conference that if coal were used as the source for all the present fuels and hydrocarbon products consumed by the United States, at their present rate of consumption, our coal reserves would last 1500 years. Supplemented by the use of present petroleum and gas products and with the prospects of atomic energy looming up, the coal would last much longer. In its present uses and at present rate of consumption, Rose, Sherman, Fieldner and others have estimated coal reserves to last from 2000 to 2500 years. Still others have estimated it would last 3000 to 5000 years. Coal and lignite constitute 98.8 per cent of our mineral fuel resources.

All this is important because it means that the foreign policies of the United States, and many of its domestic policies, can be designed without

Fig. 2. Looking down on open cut at blower assembly, (center), steam boiler, (right) and west stack (left)

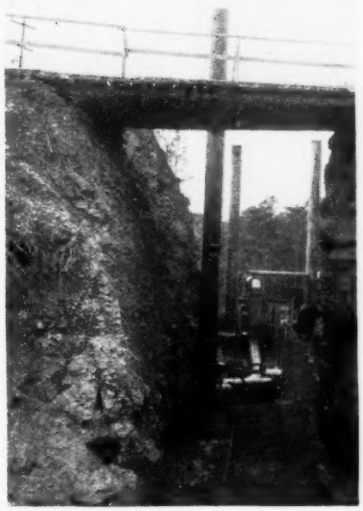


Fig. 3. Looking through open cut, panel of coal being gasified is at left; view shows blower, boiler piping

making fuels, lubricants or their by-products a dominant factor. Despite short-term disturbances in the coal industry, caused by some of the factors mentioned by George H. Love in the August issue, page 130, it is still possible to adopt a long-range optimism for this industry. It is going to be the basic source of energy of the country for a long time.

How Gorgas Experiment was Conducted

What are the physical bases of the underground coal gasification processes that have aroused so much interest?

The recent experiment conducted at the Gorgas mine at Jasper, Alabama was begn in September 1946, when Dr. Milton H. Feis, manager of coal operations of Alabama Power Co. proposed to the U. S. Bureau of Mines a full-scale trial to obtain some specific data. The power company has a 200,000-kw power plant about ¾ mile from the mine and plans another at Gadsden, Alabama. Hence it is naturally interested in developing low-cost fuel.

The power company provided a suitable isolated area of coal on its Gorgas properties, also supplies and equipment and the tests were begun in January, 1947 by the methods shown in the accompanying illustrations. The photographs were taken by George D. Creelman, Director of Research, the M. A. Hanna Co. and are used by courtesy of the Ohio State University Engineering Experiment Station News, where they first appeared in an account of the experiment by Gerard C. Gambs, also with the permission of Dr. Feis.

Because of the paucity of real information about the Russian work in coal gasification, the work had to be done from scratch. For example, most of the Russian coal gasification work has been done in inclined seams, has yielded little information on effect of water in the overburden, also on construction of barriers to limit the burning of coal in the mine in a given area. None of this can be found in the literature. Until such data are available, the natural choice would be a flat seam with a slight pitch toward a common point, beginning the process at the highest point.

In carrying out the experiment at Gorgas mine, Dr. Feis gives particular credit to Dr. Sayers and Dr. Fieldner of the Bureau of Mines and to James Elder, chemical engineer, and James Dowd, mining engineer, both of the Bureau, for their fine work. The work of Harry Johnstone, manager of the Gorgas mine for Alabama Power Co., was outstanding. Dr. Feis praises very highly the co-operation of all concerned and commends the Bureau as one to be emulated by all other arms of the Government.

Details of Area Gasified

These men and their assistants isolated a section of the Gorgas mine as shown in plan view in Fig. 1. A portion of the mine was selected where a small peninsular strip about 150 ft wide and 300 ft long could be cut off from the main bed by a 20-ft trench. The coal vein, 36-in. thick, was horizontal and through it was cut a U-shaped combustion duct as shown. This had one entry 170 ft long, the other 140 ft long, both 6 ft wide, the two connected by a cross-cut 46 ft long and 6 ft wide.

Bags of clay were placed along the walls of the entries and reduced the tendency of burn-outs to break through.

Concrete stoppings were placed in the opening of each entry, an air blower was installed, piped and valved as shown and stacks about 40 ft high were erected. See Figs. 2 and 3. A number of 4-in. pipes were sunk for insertion of thermocouples, pressure taps and gas sampling connections. Pyrex glass vision slots were provided,

Fig. 4. West side of coal area being gasified, showing entrances to observation adits. Pipes on top, for measuring devices, extend down to coal seam

Fig. 5. Interior of an observation tunnel. Center—Pyrex vision slit. Left center—Water gage or manometer for pressure differentials produced by air flow. Right—Thermocouple wires out to instruments

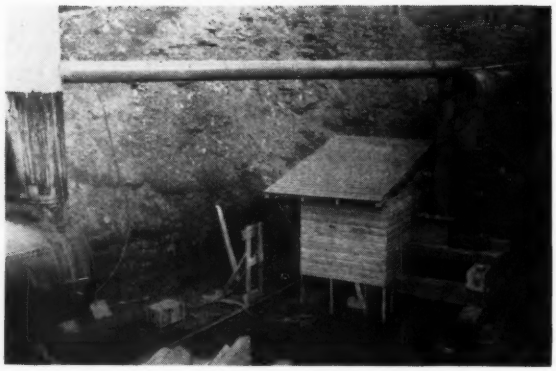


Fig. 6. View of the blower (right) and steam boiler (left)

set in eight adits 3 ft high and 6 in. wide, as shown in Fig. 4 and Fig. 5. Details of these observation posts are shown in Fig. 5. In Fig. 6 is shown the blower installation and part of a steam boiler supplying steam for the purposes described below.

To begin the experiment, the coal was ignited by dropping incendiary bombs down 4-in. holes into some broken coal placed in the cross-cut. Air from the blower was admitted to one tunnel entry to provide oxygen for combustion. The resulting gases consisted chiefly of CO, CO_2, CH_4, H_2 and N_2. They escaped through the other tunnel and exhausted through its stack.

The experiment demonstrated, according to Dr. Feis and the Bureau of Mines, that there is little doubt that gas suitable for production of synthetic liquid fuels and chemical by-products, for use in gas turbines or for burning in power boilers, can be produced in this way under proper conditions. Also the elimination of many of the hazards of coal mining would be an important factor in the process. No miracles were expected from the Gorgas experiment. The road ahead is long and difficult. The job was undertaken to determine whether or not combustion could be maintained and controlled underground and to find out how the roof would act, although no other might act like it. Calorific value of the gas was important only at times.

Important Facts Determined

After the fire was extinguished, it was found that the shallow overburden, only 30 ft, allowed burn-outs, which had limited air input to around 1400 cfm at 1.5 psi. This in turn prevented reaching the desired temperature during air blasting, so that the heat value of gas was held between 50 and 100 Btu per cu ft, although some of 150 Btu was produced when 200 cfm of oxygen was introduced. When steam only was admitted, a gas of 291 Btu was produced. A full technical report on these tests will be published by the Bureau of Mines and a paper is being prepared for delivery before a joint AIME-ASME meeting in October.

It developed that the observation cross-cuts were not properly designed and some burned out early in the tests. The blower was second-hand and of limited capacity but to await a new one would have delayed the tests 18 months.

Plasticizing of Roof

The strata over the coal in this test swelled from the heat of combustion, attaining a semi-plastic stage, and in this expansion it filled up the area formerly occupied by the burned coal and supported the roof above. The top portion of the seam burned in advance of the bottom and the face of the coal had an angle of 60 deg. There was sufficient space between fallen pieces to permit air passage. The coal was burned clean, very little coke and the ashes were on the bottom. Falls appeared to clog the entries, yet there was a comparatively free passage of air in starting the blower after the experiment.

Much further study and additional experiments are necessary. Yet, when the results are considered together with the reports from Russia, Belgium, Britain, plus a rumor, which will not be silenced, that a chemical company is now gasifying coal underground and piping the gas 8 miles—surely there is enough to justify further work. Engineers may expect to see more experiments conducted in other seams in coal-producing states in this country.

How The Russians Have Gasified Coal

Concerning the Russian experiments, some information was given in a paper by G. O. Nusinov in 1943. According to a translation of it published in *Canadian Chemistry and Process Industries*, preliminary work in Russia in 1931-33 resulted in the formation of the Podzemgaz organization, which chose sites for gas works. A series of plants was set up in Lower Moscow, Donetz, Kuznetsk and elsewhere for utilizing gas from coal for power generation and for operating chemical plants.

Coals selected vary greatly but all are in deposits unprofitable to mine. They are either low in grade, exist in thin seams, dip steeply, tend to ignite spontaneously, are high in ash, or exhibit a combination of these disadvantages.

Three Russian Methods

Three principal methods of gasification have been proposed: the borehole-producer, the stream, and the percolation. The first of these envisions sinking two shafts, some distance apart, to the coal vein and interconnecting them at about 5-yard intervals with 4-in.-diameter holes bored through the coal. The idea is to light fires in groups of these boreholes in succession and then to send air, sometimes with steam added, down one shaft to force the gases up the other. This process, theoretically, burns a maximum of coal, is applicable to either horizontal or inclined seams, but necessitates considerable underground labor to excavate the boreholes.

The stream method calls for the sinking of two shafts, as before, and connecting them at the bottom with a gallery, where the fire is started. The percolation system is similar to the scheme proposed by Betts, an

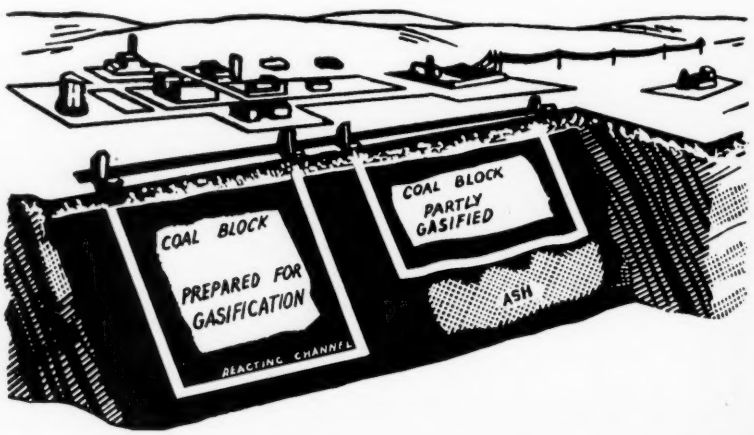


Fig. 7. Diagram showing Russian method of preparing tilted panel of coal for gasification. Shafts contain pipes through which air for combustion is sent down and others through which generated gas reaches surface. (Nusinov, through *Canadian Chemistry and Process Industries*, via *Compressed Air Magazine*)

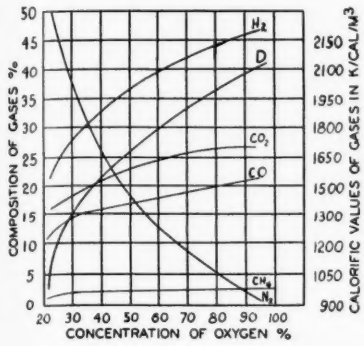


Fig. 8. Effect of oxygen and composition and heat value of gases in underground coal burning. Curve D represents combined gases produced (Nusinov; *Ibid)*

American, in his original patent, taken out in England in 1909, and eliminates much of the preliminary work. Borings are made from the surface in concentric rings from 20 to 40 yards apart. Some of those in the inner ring are ignited first and air is forced down through them. In loose ground, the coal will burn along the seam to adjacent holes, from which the gas will emerge. Holes are lighted progressively, working gradually from the center outward.

Details of Stream Method

Nusinov's paper, which is summarized from the Canadian magazine by *Compressed Air Magazine,* deals with the stream method exclusively, indicating that it was adopted in preference to the others. An accompanying diagram shows how it has been applied to a steeply-inclined coal seam. Dimensions of the shafts and gallery are not given, but it is understood that there is a panel of coal, containing around 11,000 to 12,000 tons, between each set of openings. As burning proceeds, there is considerable caving of the overlying rock and the underground cross channel assumes a chaotic shape, but it is stated that at no time does it become completely obstructed.

"As is the case with gas made from coal in conventional retorts," continues *Compressed Air,* "underground gasification is effected in several stages. Near the point where the coal is ignited, adjacent to one shaft, is a zone of oxidation. Farther along the passage is a zone of reduction, and at the far end is a zone of dry distillation. Maximum combustion takes place in the areas closest to the air shaft where oxygen is available and, as a result, there is a tendency towards uneven burning. To offset this somewhat, it is the practice to reverse the direction of the air flow at regular intervals.

Heat Values and Production of Russian Gases

"All gas produced, up to the time the Nusinov paper was written, was of low calorific value that could be considerably increased, however, by enriching the oxygen content of the air. At the Gorloff Station the gas had a rating of 93.2 Btu per cu ft when air was supplied, and of 191 Btu when the proportion of oxygen was raised to 60 per cent. This station operated for a year and a half, being interrupted by the German invasion, and produced approximately 2,650,000,000 cu ft of gas, which was at first used for generating steam and later for heating retorts.

"The gas obtained by introducing air alone was called 'energetized' and was the principal product of the Gorloff Station. At the Lissichansk Station, on the other hand, a 'technological' gas was made by adding oxygen to the feed. But in this instance the roof over the coal was strong, so that it did not cave much, and the channel remained open enough so that some of the entering air was carried through to the discharge shaft, where it burned with a considerable amount of the generator gas. As a result, the gas obtained with an input containing 50-60 per cent oxygen had a heat value of only 120.2 Btu per cu ft. Eventually this difficulty was overcome by blasting down a part of the roof and by introducing backfill from the surface. This station ran from February to September, 1941, and produced 1,410,000,000 cu ft of gas.

Details of Russian Methods

"The Podmoskov Station encountered operating troubles in the form of open channels that permitted much of the air sent down the shaft to become dissipated. In consequence, various crevices had to be sealed with cement and clay. This station had generated 1,060,000,000 cu ft of gas up to the time the Nusinov paper was prepared. When air alone was supplied, the gas had a heat value of from 89 to 101 Btu per cu ft. With the addition of 25-30 per cent oxygen, it was increased to values between 112.3 to 123.6 Btu. Some of the gas was used in brickmaking plants.

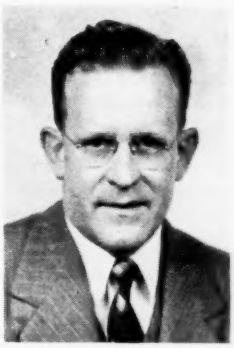
"The principal point of interest in connection with the Podmoskov Station, according to Nusinov, was the development of a method that eliminated labor in driving the subterranean cross channel. After two shafts had been sunk to the layer of coal, air was forced down one of them under pressure. Diffusing through crevices and pores in the coal seam, it gradually burned out a channel extending to the bottom of the other shaft. The process of gasification then commenced in the usual manner.

"Reports from Russia, all unverified and hence open to question, have at various times dealt with the economics of gasification in a general way. One claimed a recovery of 80 to 90 per cent of the heat value of a coal bed, as compared with 60 per cent by normal mining methods. Another, in 1941, indicated that only 15 per cent of the labor force at a gasification station worked underground, as against 70 per cent in coal mines. Production per man, measured in heat units, was said to be four times greater than when coal was mined."

JOHN CALVIN GORE

JOHN C. GORE, Chief Operating Engineer for the Post Cereal Div., General Foods Corp., Battle Creek, Mich., died recently at Ann Arbor, Mich. He would have been 39 years of age on September 13.

A graduate of Carnegie Institute of Technology, Mr. Gore went to work for Babcock & Wilcox Co. as a Field Engineer with headquarters in Pittsburgh and Barbeton, Ohio. It was of his experience while working with B & W that Mr. Gore wrote so interestingly. His articles on "Placing the Steam Generator in Operation," (POWER PLANT ENGINEERING, May and June 1947) gave a vivid picture of the life of a field engineer at the critical point in the operation of the large power plant. A series of articles on this subject had been arranged for but these, of course, will not appear.



Mr. Gore was extremely active in the engineering affairs of his state; he was a member of the Battle Creek Engineers' Club, the Michigan Engineering Society, and was vice president of the Kalamazoo Valley Chief Engineers' Club.

Mr. Gore was born in Beaver Falls, Pa., September 13, 1908. His attendance at Carnegie Institute was made possible only by dint of extreme effort on his part. He worked at the Beaver Falls Plant of Armstrong Cork Co. while going to college and had to drive 80 miles each evening to get to school and return home. Not content with going to school Mr. Gore also was awarded three Student Council Activity keys and was made a member of Phi Nu fraternity.

Mr. Gore is survived by his wife, the former Mary Elizabeth Fisher of New Brighton, Pa.; three daughters, Patricia, Joan and Elizabeth and a son, James; a sister, Mrs. James Flocker of Upland, Calif., and a brother, T. L. Gore of Pittsburgh.

How to Operate and Maintain Water Tube Cleaners

Types of cleaners described . . . Operating pressures . . . Types of drills and cutter heads . . . Use of brushes . . . Correct methods of operation . . . Importance of proper size of cutter head in various sizes of tubing . . . Reasons why motors are of different sizes . . . Maintenance and repair

IN SPITE of feedwater treatments of the most elaborate nature practically all power plants are forced, at times, to employ tube cleaning equipment on their boilers, heat exchangers, condensers and evaporators. Solid matter also collects on the walls of pipe in service; mill scale must be removed from new pipe.

Types of Cleaners

Tube cleaners fall roughly into three classifications according to the motive power—water-driven, air or steam-driven and (for the cleaners for small tubes) electrically driven. Late developments in the field have provided operators with water and air-driven motors of much higher power and lower air and water consumption than were heretofore available.

Operating Pressures

Air motors generally are designed for operation at 80 to 90 psi but when these air motors are operated on steam 90 psi is the generally accepted pressure. Water driven cleaners usually operate most successfully at pressures from 130 to 150 psi.

Drills and Cutter Heads

Many types of cutter heads are available from different manufacturers but usually they may be placed in fairly definite family groups with differences appearing only in construction details.

There is, unfortunately, no universal head which can be employed for removing any and all types of scale and deposit under all conditions.

Swinging Arm Type—In this type of cutter head the cutters are thrown outward and into contact with the scale by centrifugal force generated by the motor. In the Quick Repair Head, which comes as close to being a general purpose cleaner as any available, a cone cutter is located on the forward part of the head and a series of finishing cutters follows. The Clipless Head is similar with the exception that no clips are used and straight cutters are employed instead of the star cutters.

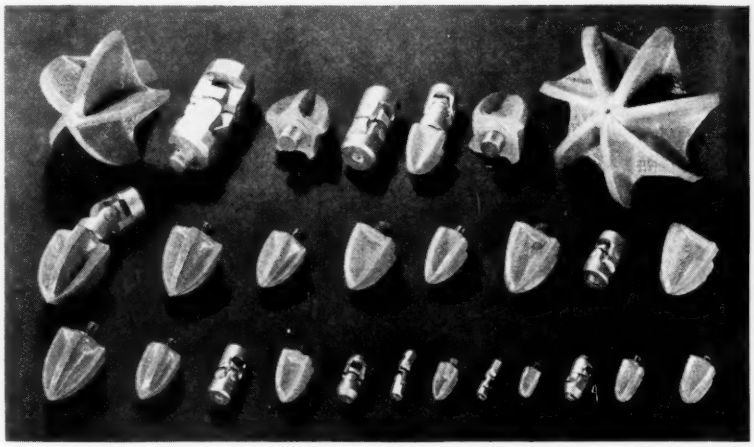


Fig. 1. This photograph illustrates the various sizes and types of drill heads and universal joints which are available for use with corresponding sizes of motors. (Photo, courtesy, Elliott Co.)

Pivoted Arm Type—Another general classification of cutter heads used in general industry and in boiler cleaning work is the Pivoted Arm Type. Depending on tube size, these cutter heads are equipped with two, three or four swinging arms which pivot on hinge pins and also, as in the previous example, are thrown outward by centrifugal force. The short cutter surface gives more concentrated force on the scale.

Single-Pin Head—In combination with a universal joint this type of head is used in cleaning very small tubes. The head is made short for use in the curves of these small tubes and combines the action of a cutter and a drill head.

Drill Heads—When used in combination with universal joints drill heads are exceptionally efficient in the removal of heavy or hard scale. Also when scale is thin and brittle it is often possible to accomplish the entire job without the use of cutting heads. Drills are used to a great extent to rough out heavy scale; the cleaning is then finished with a cutting head which removes patches of scale.

Brushes

Many sizes and types of brushes are available for use with tube cleaner motors in the cleaning of soft sludge or soot from tubes, removing scale from boiler drums, cleaning the inside seat of boiler header caps.

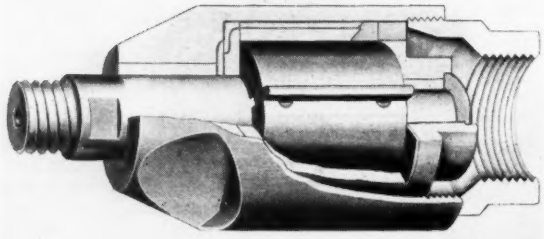


Fig. 2. This sectional view of an air or steam-driven motor for straight or curbed tubes shows the relatively simple construction of motors. It does not, however, show the close tolerances to which they are manufactured. (Photo by courtesy, Elliott Co.)

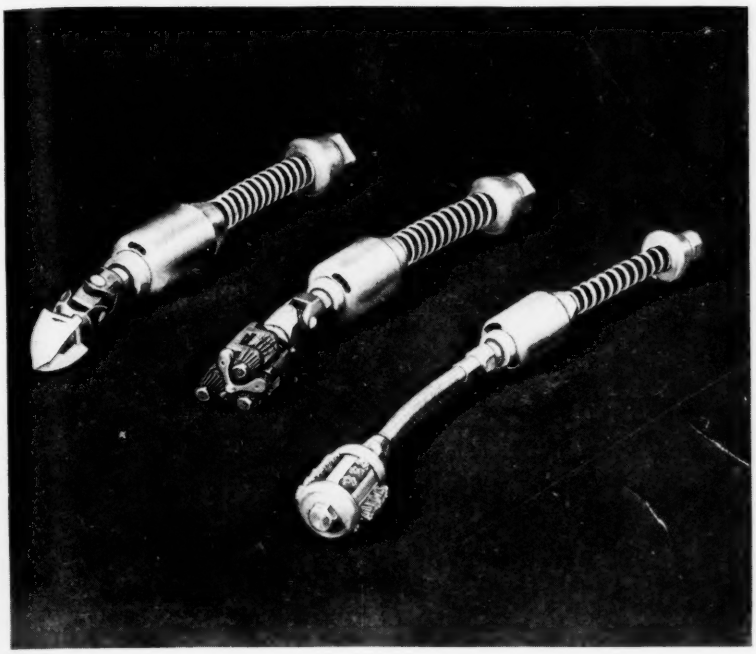


Fig. 3. Here are three air or steam-driven motors with, left to right, drill head and cutter head with universal joint and, an expanding brush with a flexible holder. (Photo, courtesy, Thomas C. Wilson, Inc.)

It is next to impossible to get operators to agree on just what the proper method of tube cleaning should be, but the majority, and the most vocal among them, protest loud and long against the use of a "pumping" motion. It is pointed out, with much logic, that best results will be obtained if the cleaner is allowed to feed through the tube only as fast as the scale is cut away.

When using self-feeding cutter heads let the cleaner feed slowly and evenly and if necessary hold back slightly on the hose so that it will not jump over hard patches of scale. If pieces of scale still have been left in the tube, allow the cleaner to run through the tube at a fairly rapid rate while sighting through the tube, (if the tubes are straight). If you can see light past the cleaner, you can be pretty sure that the cutter is doing a good job.

Opponents of the pumping motion also call attention to the fact that this back-and-forth style brings the cutter head into contact with the metal of the tube for approximately one-half the time cleaning is taking place. This means tube abrasions and rapid wear on the cutters. Too-rapid feeding of the cleaner into the tube has resulted, in some instances, in the locking of the cleaner in the tube. The ensuing blood, sweat and tears are easy to visualize.

When using air or steam-driven units a small water hose should be placed in the front end of the tube in order to flush away the scale and eliminate objectionable dust. Two more precautions it would be well to observe are: (1) Never start the cleaner until the cutter head and motor are inside the tube. (2) Do not let the cutting head come out the far end of the tube. This might result in a broken cutter head. Mark the proper distance on the hose and watch it carefully.

Importance of Correct Sizes

Too much stress can not be placed on the importance of correct application of cutter heads. Each head has a minimum and maximum throw and the head must be used in tubes where the diameter of the tube remains within the range of the cutter head. It is possible for a cutter head to destroy itself if the cutter can not reach the walls of the tube at all times. Cutter heads tend to center themselves and the motor in the tube and this is impossible if the tube is too large. The result is that the cutter head will develop a scraping and vibrating action and the cutters will become chipped. The operator will be able to recognize this fault because the vibration will be transmitted through the hose.

Motors, too, are built for every size tube. This is done for two reasons; first, to make available as large and powerful a motor as possible for each job, and second, to fit the motor to within 3/16 in. for straight tubes, of the diameter of the tube. A motor with too much clearance will wreck itself by excessive vibration and through the battering of the tube wall. Excessive shaft breakage and front bearing wear (the importance of the front bearing will be discussed later) will probably show up but the motor body will suffer most. Inspect the motor for marks on its front end and for loosening of the coupling at the rear of the motor.

When attaching a new motor to the end of the hose, pour oil into the hose connection end of the motor and also into the exhaust ports in the front and turn the shaft over by hand 10 or 12 times. If the hose itself is new, attach it to the air supply and blow it out. Fill the sight feed lubricator with oil and blow oil through the hose before attaching it to the motor. Be sure, in all cases, that oil

(Continued on page 136)

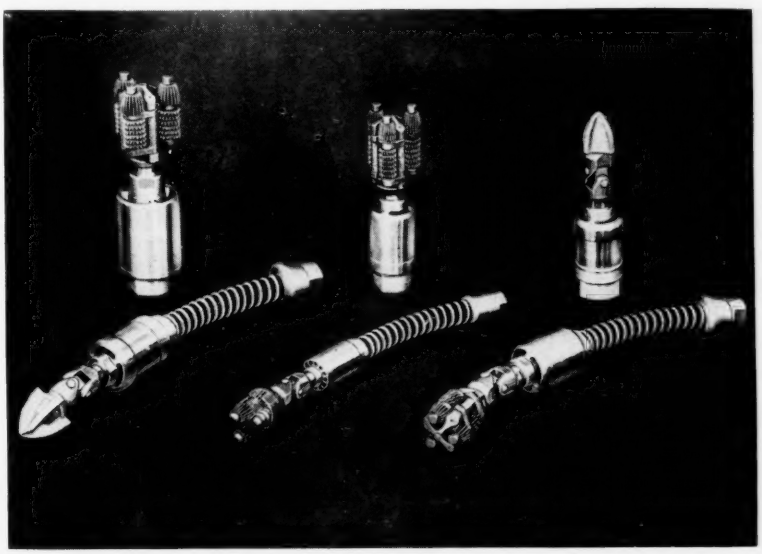


Fig. 4. These are water-driven motors with accessories attached. A universal joint is always used between motor and cutter head when cleaning curved tubes. (Photo courtesy, Thomas C. Wilson, Inc.)

WHAT THE POWER ENGINEER SHOULD KNOW ABOUT

Electrostatic Precipitators

Fundamental principles . . . Cottrell's early work . . . Types of Electrostatic Precipitators. . . Electrical features . . . Need for Rectifiers . . . Mechanical rectifiers . . . Electron tube rectifiers . . . Why a ballast resistance must be used . . . Dry precipitators . . . Wet precipitators . . . Removal of collected material . . . Precipitator shells . . . Application of the electrostatic precipitator in power plants

ELECTROSTATIC PRECIPITATION is a fearsome term. It sounds complicated; very technical—something very hard to understand. Yet it is very simple. The principle is neither complicated nor new. Perhaps you remember a simple grade-school experiment where you drew a rubber comb or fountain pen through your hair and then watched it attract dry dust or tiny bits of paper. That was electrostatic attraction. An electrostatic precipitator uses exactly the same principle to pick up dust from streams of gas. In an electrostatic precipitator, dust-laden gas or air is made to pass between electrically charged plates or wires and the electrified particles of dust are attracted to the plates where they remain until the deposit is washed, knocked or scraped off. That's really all there is to it.

Observers had noted the effect of electrical discharges through smoke-filled gases as early as 1771. In subsequent years many independent investigators studied the principle but because of the primitive nature of high-voltage electric generating devices no really practical system for the collection of dust was made until 1905. Then, Dr. Frederick Cottrell, professor of physical chemistry at the University of California, concluded a series of experiments that resulted in the installation of the first commercial precipitator. Dr. Cottrell had become interested in the precipitation of sulphuric-acid mist, which was becoming a serious problem in some industries. After experimenting with centrifugal methods, he turned to the prinicple of electrostatic precipitation. Cottrell realized that a better source of high potential electrical energy was necessary to make the principle work and he adopted the mechanical rectifier and a-c transformer to provide the high-potential unidirectional charges that were necessary.

The purpose of a precipitator is to collect particles of solids and liquids suspended in industrial gases. Smoke, for example, is a suspension of small solid particles in such density that they can be seen. Remove these solids and only the invisible gas remains. The Cottrell precipitator was first used in the chemical industry to precipitate sulphuric-acid mist. Later, it was used to recover other finely divided products in the chemical industries. Still later, it was used in the stacks of power plants to eliminate smoke nuisance.

An electrostatic precipitator consists, essentially, of two parts or rather two groups of equipment; 1. the equipment for producing the high-voltage direct current and, 2. the precipitator chamber in which the gas is treated. The voltage needed varies, depending upon the purpose for which the precipitator is used. Usually it ranges from 15,000 v to 100,000 or over. Such voltages are easily obtainable by means of step-up transformers. However, since unidirectional voltage is required it is necessary to rectify the high-voltage alternating current before applying it to the elements of the precipitator. This can be done by the use of a simple synchronous, mechanical rectifier, as first used by Cottrell, or it can be done by electron-tube rectifiers.

Methods of Precipitation

In general two methods of electrical precipitation are available; single stage and two stage. Cottrell recognized that the simplest and nearly always the most effective method was to charge and precipitate the particles in a single stage, by the same field and in the same space. He used this principle in the first commercial precipitator installed at Selby to precipitate sulphuric-acid mist. The two stage method, in which the particles are charged and precipitated in separate fields or stages, proved less generally applicable, even though it has certain advantages in specific instances. (see Fig. 2).

A diagram of an electrostatic precipitator using a mechanical rectifier is shown in Figs. 1 and 5. The precipitator is shown as a single metal tube, down the center of which is suspended a single wire. The tube is grounded and connected to the positive terminal of the rectifier while the wire is connected to the negative terminal.

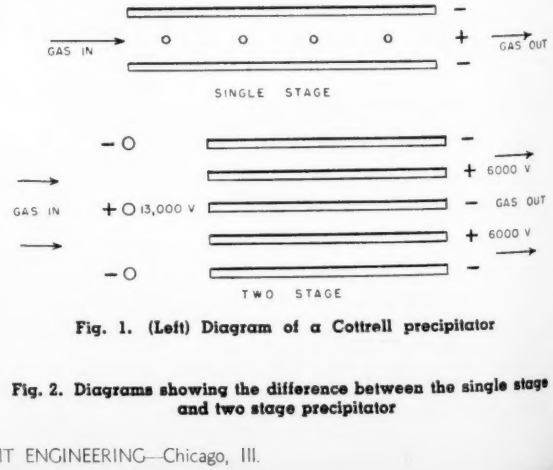


Fig. 1. (Left) Diagram of a Cottrell precipitator

Fig. 2. Diagrams showing the difference between the single stage and two stage precipitator

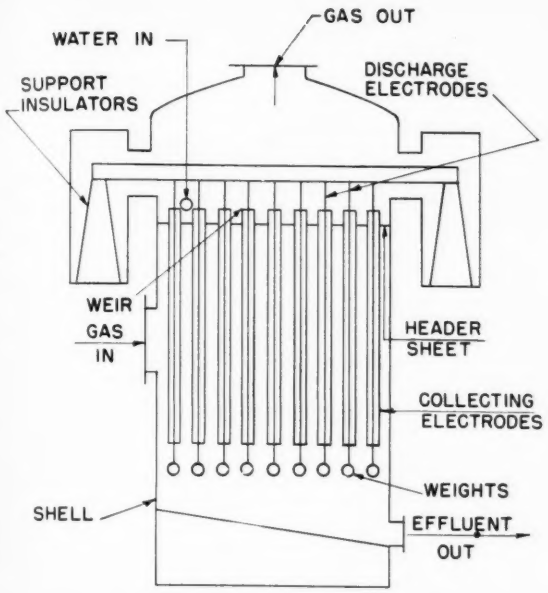


Fig. 3. Cross sectional diagram of a wet (tube type) precipitator

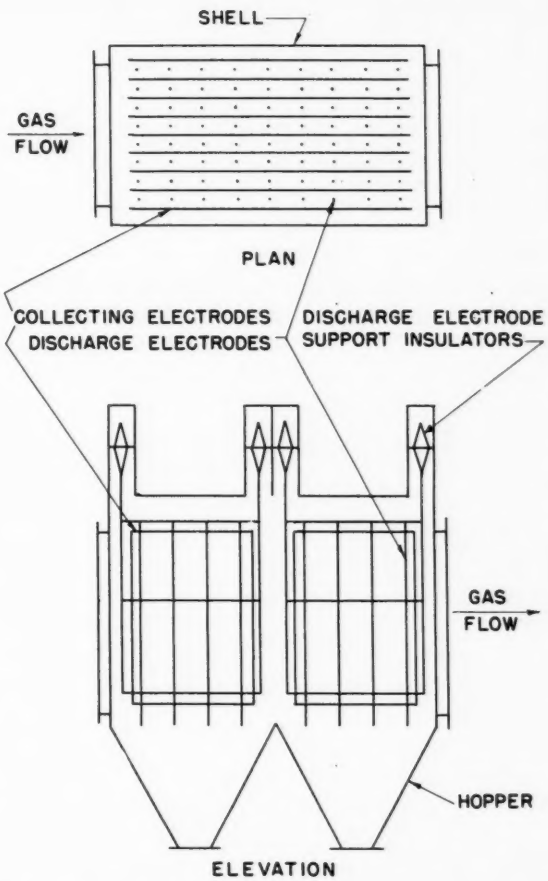


Fig. 4. (Right) Horizontal gas flow, dry type precipitator

The rectifier consists of an insulated disk mounted on the shaft of a synchronous motor. The disk carries on its periphery two metal quadrants each having two arcing tips as shown in Fig. 5. The disk is surrounded by four stationary shoes two of which are connected to the terminals of the high-voltage transformer. The whole arrangement is a synchronously driven, make and break switch which always connects the transformer to the precipitator elements so that the polarity on the elements remains unchanged.

Mechanical vs Tube Rectifiers

With both the mechanical and electronic rectifiers, of course, are associated suitable control equipment. In the mechanical rectifier system this includes a motor contactor, a main contactor for connecting the transformer, an overload relay, an ammeter, a voltmeter, a transformer tap switch, a tap switch for varying the ballast resistance in the transformer primary, signal relay and the necessary push buttons for operating the motor and transformer contactors.

In the case of the electron tube rectifier the associated switchboard equipment is similar except that the polarity selector and motor contactor are not required. Instead there is included a rheostat for adjusting the primary voltage to the filament transformers, a time delay relay for applying plate voltage after the filaments are heated.

As far as recovery efficiency is concerned there is little to choose from by the use of one type of rectifier or the other. The electron tube rectifier makes possible the elimination of high speed moving parts and associated noise and in places where explosive gases or dusts are involved, they are very desirable. The electron-tube rectifier was not used extensively for precipitation purposes until recently in connection with high octane gasoline plants. This has been principally because of short tube life. The tube manufacturers limit the guarantee of tubes to 1000 hr and early installations gave poor performance in this regard. Recent experience in gasoline plants, however, shows that many tubes last in excess of 6000 hr and some have been in operation as long as 9000 hr.

This does not mean that tubes may be expected to last 6000 hr or more. Tube life depends upon many factors other than their inherent construction and it is hard to make predictions in regard to their life.

The electron tube rectifier requires slightly less space than the mechanical rectifier but its control is slightly more complicated. As regards explosion hazard, the selection of one or the other types depends largely upon the location of the installation. Mechanical rectifiers have been operated successfully in high octane gasoline plants and also in gas plants where precipitators are used for detarring purposes. The power consumption of mechanical rectifiers and tube rectifiers are about the same.

Ballast Resistance

The efficient operation of Cottrell electrostatic precipitators depends upon the application of high voltage at a value close to that which would produce arcing between the electrodes, in fact, the potential should be carried at a value so close to the arcing point that occasional flashovers occur. To prevent such flashovers from becoming power arcs, a balancing resistance is connected in the primary circuit of the transformer. When an arc is established, it produces an immediate fall in potential due to the IR drop, which in turn reduces the voltage to a point where the arc will not persist. Some of this resistance is in the form of fixed resistance and some of it is in the form of variable resistance. This accounts for the fact that precipitation transformers have a primary voltage rating less than the nominal voltage of the line to which they have to be connected.

Types of Precipitators

In general, two types of electrostatic precipitators are available, the wet type and the dry type. Precipitators for use in power plants, where they are used for the removal of fly ash and soot from flue gas, are always of the dry type. In many chemical processes, however, the wet type is preferable. The wet type is usually of the pipe

type. These precipitators are built in a cylindrical tank having a header sheet near the inside top. In this header sheet are nested pipes which act as collecting electrodes. The high voltage ionizing electrodes in the form of wires are supported from above the header sheet and hang axially in the collecting-electrode pipe. Water is introduced above the header sheet and flows over carefully leveled weir rings at the tops of the pipes to form a water film on the inside of the pipes. The charged particles are collected in the water film, where they are electrically neutralized and drained off from the bottom of the precipitator with the water.

The plate or duct type of precipitator is usually used for the removal of dry dusts such as are contained in flue gas in power plants. This type is composed of a series of parallel plates encased in a shell, thus forming ducts or gas passages. They are built for either horizontal or vertical gas flow. The discharge electrodes are suspended in the centers of the ducts from an insulated framework.

It is highly essential that the high voltage ionizing electrodes be accurately centered between the collecting electrodes. If they are not properly centered it will not be possible to maintain maximum voltage and the collection efficiency will be impaired. It is very necessary, therefore, that the supporting structure be stable and multiple point support or suspension is desirable. Single and two-point suspension is sometimes used by hanging weights on the bottom ends of the discharge electrodes to increase the inertia of the electrode system and thus reduce the tendency towards swinging. This, however, increases the weight of the precipitator.

The discharge electrodes themselves must either be small or have sharp edges to facilitate the formation of corona. Two forms of discharge electrode are often used; steel wire and twisted square steel rods.

Removal of Collected Material

A very important part of precipitator operation is the removal of the dust from the collecting electrodes without redispersing it in the gas stream. In the dry types this is usually done by "rapping" that is, by striking the collecting electrodes by mechanically or electrically operated hammers or "rappers". Various kinds of rappers are used, some being manually operated but in most cases the rapping intervals are timed automatically. Automatic rapping is usually accomplished by synchronous motor riven cams which operate contactors and these in turn actuate the rappers which may be motor driven or compressed air driven. The rappers for high voltage discharge electrodes must be insulated from ground at all times, hence, it is important that the compressed air for air-actuated rappers be dry and clean.

To prevent redispersion of the dust into the gas stream during rapping, the collection electrodes are often equipped with pockets into which the dust falls when it detaches from the electrode surfaces. This is very important in power plant work where the sole purpose of the precipitator is the elimination of fly ash and soot from the stack gases.

Precipitator Shells

Various forms of shells or enclosures are used with dry type precipitators. The choice of material depends upon local conditions. For power plant application, precipitator shells are usually built of steel or reinforced concrete. Sometimes reinforced concrete supports and frame is used with brick or tile walls. The choice of materials is dictated principally by availability and cost of labor and materials. Construction of reinforced concrete or combination of brick and concrete usually involve several of the building trades. Steel construction permits shop fabrication in relatively large pieces and field erection by one of the metal trades. Electricians, pipe fitters and millwrights are normally required for erection in any case.

Cottrell electrostatic precipitators can be designed for any desired capacity, from a few thousand cfm to several million. They can be designed for any desired efficiency up to 99 per cent or over of the total suspended matter entering the precipitator and they can be designed to operate with temperatures as high as 1200 F by the use of proper materials.

A great deal more could be said about the actual design and operation of electrostatic precipitators but this article will acquaint the practical operating engineer with the essential details and principle of operation. There are special types of precipitators such as the Precipitron made by Westinghouse Electric Corporation but these are used mostly for industrial applications — for the removal of dust from factories, laboratories, hospitals, stores and homes. The Precipitron is a two stage precipitator, built in compact form, very flexible in its application but it has not been used, so far as is known, for the removal of dust and fly ash from flue gas in the stacks of power plants.

Where Cottrell precipitators are used for the removal of dust and fly ash from flue gas in power plants, they are usually installed on the roof of the plant.

For additional information regarding electrostatic precipitators the reader is referred to a booklet entitled Cottrell Electrical Precipitators published by The Western Precipitation Company, from which much of the data in this article was taken. Credit is extended also to the Research Corporation of New York, to the Koppers Company, Inc., the Thermix Corporation and to the American Air Filter Corporation for assistance in submitting data for this article. (AWK)

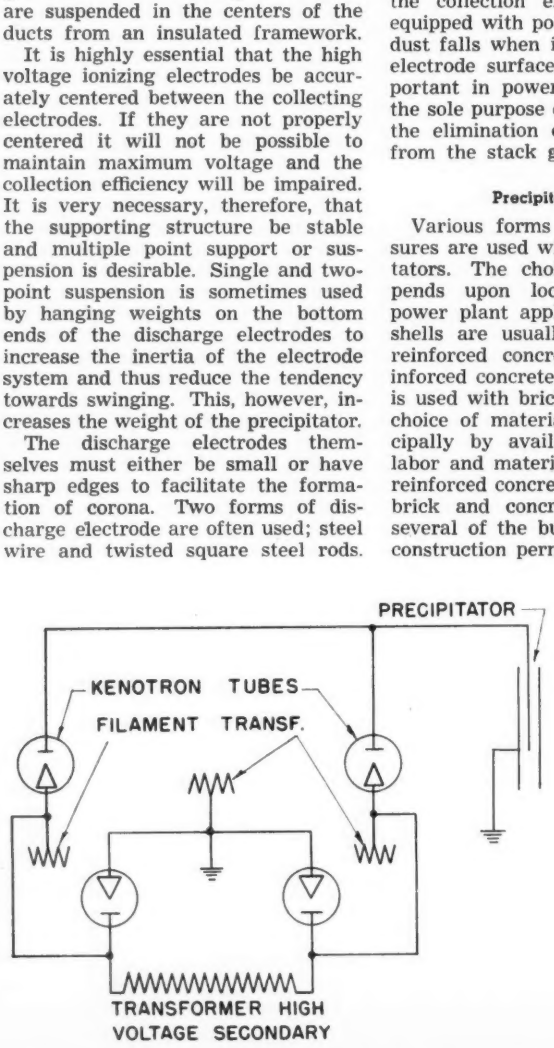


Fig. 5. Precipitator employing mechanical type synchronous rectifier

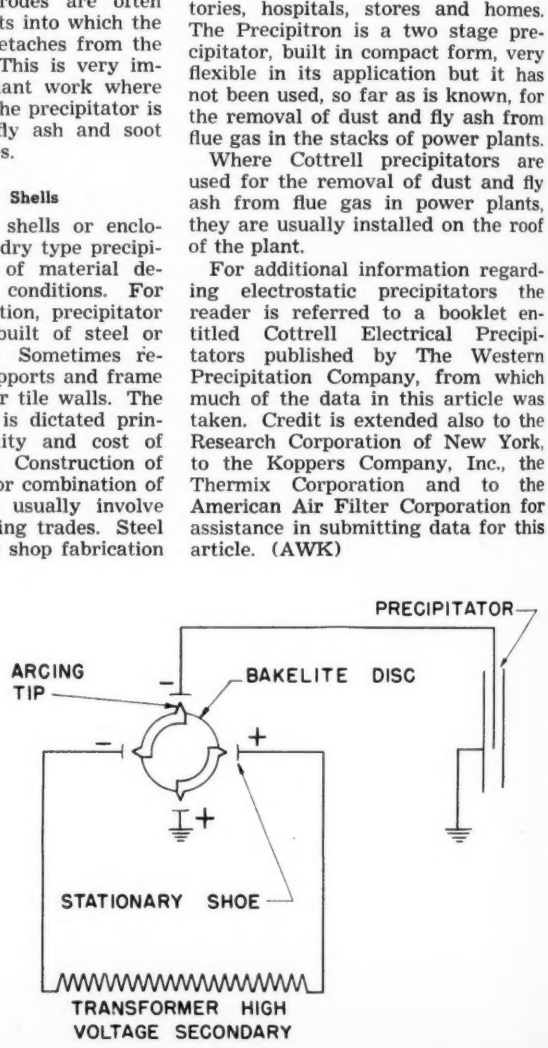


Fig. 6. Diagram of a precipitator using an electron tube type of rectifier

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

☆

GUESS WE COULD USE HIM

Maybe some of you remember the little squib on page 90 of the July issue on Wattage and Current Relations in Resistors? Well, we made a bad "bull" in that—a glaring error in other words, but nobody around here, including ye Editor noticed it, not until it was too late and it was crystallized in undying print.

The wattage in a resistor, the article said, varies as the square of the current. Then, we went on to show that if the current in a resistor increased by 10 per cent, the wattage increased by 2 per cent! This, of course, is nuts—it doesn't make sense. Actually, the wattage increases by 21 per cent. Why? Simply because 1.1 x 1.1 = 1.21. Exactly, the same as when current increases by 20 per cent, the wattage changes by 1.2 x 1.2 = 1.44. We *did* get the 44 per cent right in the article.

These slips are sure embarrassing but they happen and somewhow we can't seem to stop them, ever. Every time one gets through, we make up our minds to do better next time—never to let them happen again, but no sooner do we resolve this, something worse happens. They say, "to err is human". Boy, we're sure human.

A chap wrote in about this 2 per cent business—calling our attention to the fact that it was wrong. Then he points out that he has just been graduated an electrical engineer and completed a lot of English courses. He wonders whether we could use a proofreader on the magazine.

We sure could.

AWK

☆

CONTENTS

Modern Boiler, Tank and Line Insulation 84
By John Ostborg

The Corliss Engine That Was Bushed 86
By William S. White

Practical Application of the Mollier Diagram—III 88
By Walter Heidecker

Steam Velocity Chart 89

Wood Decay Survey Launched 89

The "Why" of Bimetal Thermometers 90
By A. H. Lamb

Repairing a Corroded Breeching 92
By C. L. Shobe

Tube Rolling 93

Practical Hints and Kinks 94
Preserving Copper Plating in Refrigerating Compressors
Hard Faving Saves Down-Time of Pulverizers
Spare Fire Hose
Shock Absorbers on Monotractor Load Bar

Letters and Comments 95
Choice of Chief Engineer Important to All
Why Can't Metaphysical Sciences Keep Up with Physical Sciences?

Questions and Answers 96
Can He Get More Power by Balancing Up 3-Phase Lighting Circuit?
Can Further Adjustment Be Made on This Engine?
How Make Forced Draft Air Follow Fuel Feed?
Why Do Duplex Pumps Slam when Feedwater Temperature Drops?
How Should He Line Hot-Water Storage Tank?
What Are Duties of Watch Engineer, Fireman, Oiler?
Can This Fan Be Improved?
He Wants Steel-Work Design for Track Supports over Coal Bunker

Chart Showing Pipe Selection by Steam Velocity 100

A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 W. Jackson Blvd., Chicago 4, Ill.

Modern Boiler, Tank and Line Insulation

Brief sketch of operating conditions at Salisbury Axle Plant at Ft. Wayne . . . Insulation techniques in covering entire distribution line . . . Advantages of applying insulation in sections . . . Insulation of deaerator, cold water make-up tank and circulating and process pumps . . . Effectiveness of insulation under test

CORRECTABLE defects in the steam system are frequently potent, though silent, money wasters. Few industrial processes are as universally important as the generation and distribution of steam for heat and power, and in most plants the generation of steam and the maintenance of the boilers, lines and auxiliary equipment constitutes an outstanding item in overhead costs.

In recent years the realization has grown that very important fuel economies result through the application of good insulation. The need for fuel conservation during the war served to accelerate the insulation of heated surfaces. All new plants, planned or erected during the war included carefully detailed plans for heat and power generation and distribution in completely protected lines from carefully insulated boilers.

The Salisbury Axle Division of the Spicer Manufacturing Co. erected a new plant in Fort Wayne, Indiana, which was placed in operation early in 1946. The boiler room is a model of efficient layout and detailed planning. The distribution system exemplifies the latest principles. No heated surface has been overlooked. All were insulated with semi-rigid mineral wool pipe forms and surface blocks.

Before describing insulation techniques, let us review the plant layout and determine those elements of the system where heat-loss-control is vital.

The power plant is housed in a separate building located conveniently to serve future plant additions. Isolation of the power plant avoids dispersion of related equipment among production tools—and, by avoiding the cramped quarters of production areas, reduces the number of people involved in operation and maintenance. With the present arrangement four men are adequate to operate and service all power equipment.

Fuel Delivery

A rail spur is available for fuel delivery and ash removal. Fuel consists of Indiana coal which is removed from rail cars with automatic machinery and stored in a silo type storage supply tower. Provision is made for freeing frozen coal by means of heaters at the unloading point which free a dozen car section in 20 minutes or less.

The coal is delivered by chute from the silo to weigh larry distribution buckets which are suspended from a monorail in front of the three furnaces. Weighed charges are placed in the hoppers which feed twin automatic spreader stokers in each unit. The performance of each boiler is continually checked by recording flue gas CO_2 analyzers and by constant check of weighed fuel consumption. Even at minimum demand, correct feeding control yields 13 per cent CO_2. Stack losses are further minimized by recovering fly ash from the rear exhaust and recirculating it through the air blast system. Maintenance and operational uniformity are further controlled by water walls in the sides and rear of the boilers.

The plant not only encloses the boilers, water feeders, deaerators and pumps but also the electric power controls and compressors for supplying compressed air to the various departments.

The power building consists of two main rooms. The larger one contains three 224 hp two drum, bent tube boilers installed by Combustion Engineering Co. Each unit is designed for continuous operation at 15,000 lb per hour of steam at 330 F and 140 psi. The production sections in operation at present require 30,000 lb per hour in the winter but use only 5,000 lb of steam for process loads, when heating is no longer required. When the final section of the plant, now in construction, is placed in operation, the total capacity of the three boilers will be required in extreme weather.

The steam is piped from each boiler to a collector and distributor manifold located on the balcony of the second room in the power building. All control valves for the main lines, to and from the furnaces, are conveniently grouped where they are easily accessible. By generating the steam at 140 lb the size of the pipes, manifolds and valves is reduced—and, of course, the amount of insulation required for control is similarly minimized.

Having briefly reviewed the plant in general, let us now pick up the insulation topic. In addition to line insulation, the feed water pumps (American Marsh Duplex), the deaerator (30,000 lb per hr, Cochrane Corp.), the 8,361

Fig. 1. These pipes carry condensate to the heat exchanger and go on to a hot water supply tank. Pipes and flanges are insulated with 1 in. formed mineral wool. Flange insulation is cut and notched to fit. Flanges and pipes have a protective cement coat and a hard and identifying coating of paint

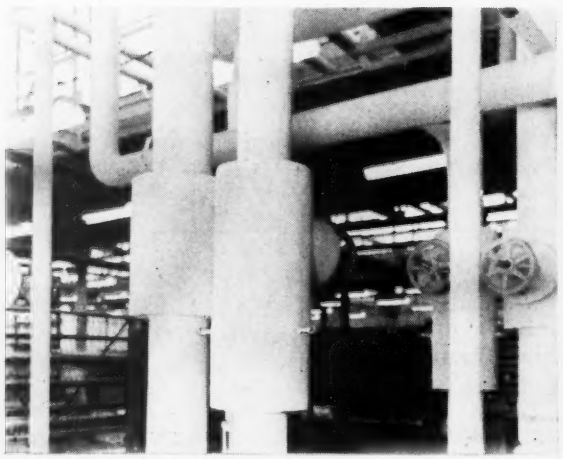
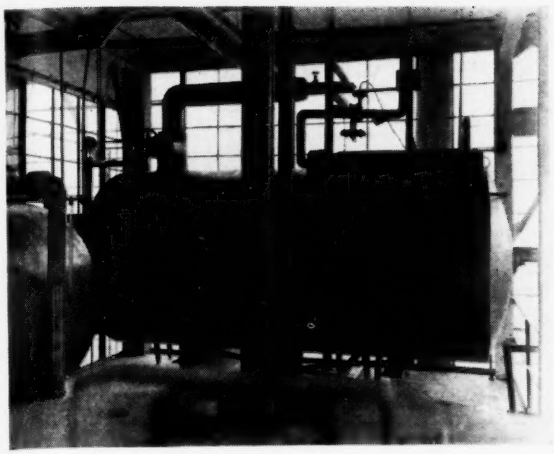


Fig. 2. 30,000 lb per hr feedwater heater and deaerator are insulated with 1 in. mineral wool blocks cemented and banded into place. Blocks are covered with canvas, coated with two layers of sealing compound and finally painted. 8,361 gal capacity tank at right is for chemical treatment of incoming water



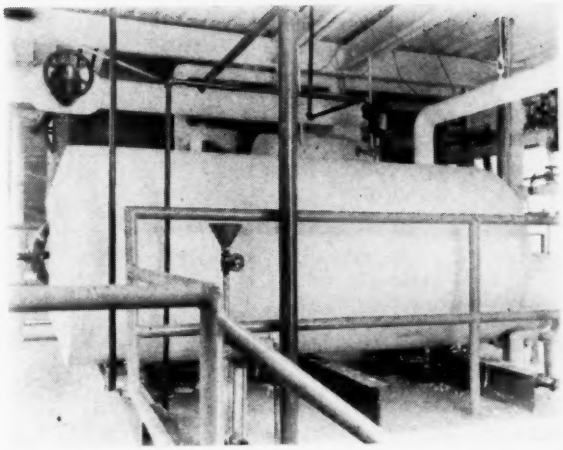


Fig. 3. This 2,000 gal cold water tank is used for well supply storage. It is insulated to prevent sweating, incoming water being considerably less than room temperature. Insulation is 1 in. mineral wool blocks, cement, and paint. Fig. 4—right. This 500 gal tank contains hot water at 180 F and is also insulated with 1 in. mineral wool blocks, covered with cement and paint

gal deaerated storage tank, and feed water heaters (Swartwout single element) are insulated.

Insulation Techniques

The entire distribution line, including all valves, pressure reducers and manifolds is insulated with 1 in. of formed, semi-rigid mineral wool pipe insulation. Application of this type of insulating material is very simple. The preformed pipe insulation is merely cemented and banded in place and covered with heavy canvas duck. The irregular surfaces of valves and manifolds are quickly fitted by notching and sawing the easily worked mineral wool to conform to each contour. The cemented insulation is banded on 12 in. centers with steel straps, covered with duck, banded again, where necessary, and the entire outer surface is painted with sealing compound over which any type of decorative and protective coating can be brushed or sprayed.

By applying the insulation in sections, maintenance and repairs which inevita-

Fig. 5. 12 in. diameter steam collector manifold and supply control valves are insulated with 1 in. mineral wool board insulation covered with 2 layers of canvas and a coating of paint

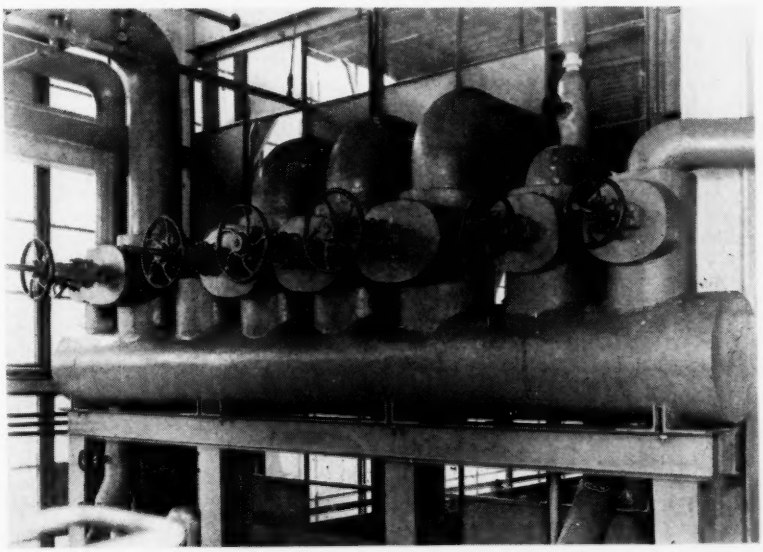
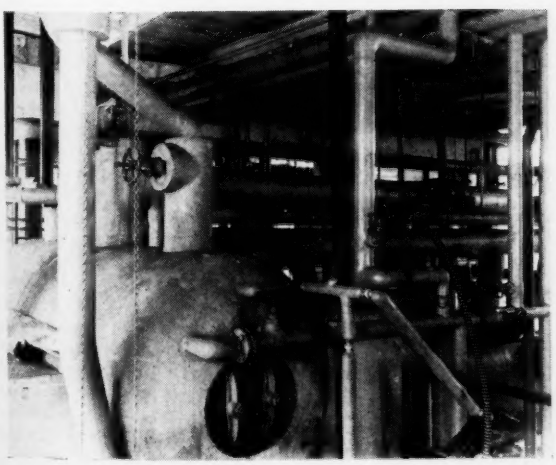
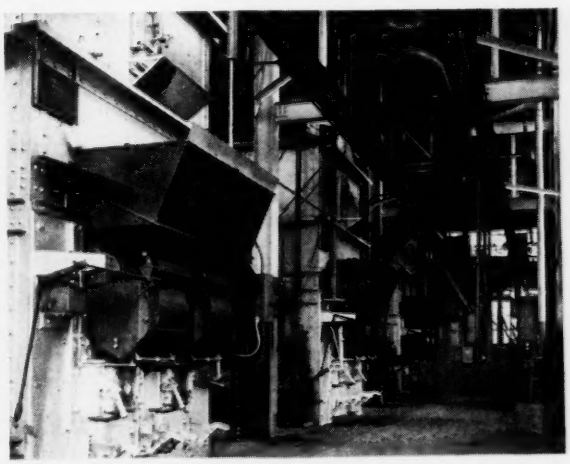


Fig. 6. Steam collection drum is insulated with 2 in. board insulation which is canvas covered, cement sealed, and painted. Steam is at 140 lb and 330 F. Mains are insulated with 1 in. formed pipe insulation and covered in the same manner as the drum insulation. Fig. 7—right. water at 180 F and is also insulated with 1 in. mineral wool blocks, covered with cement and paint





bly must be done on high pressure steam lines, are simplified. Removal of sections does not impair the insulating value of adjacent sections, and the high mechanical strength of mineral wool pipe insulation eliminated the wasteful powdering, sifting, settling and such defects frequently encountered in other rigid pipe insulation.

The deaerator is insulated with 1 in. semi-rigid mineral wool blocks, cemented and banded into place, covered with canvas and coated with two layers of sealing compound and two coats of paint. The deaerator water storage tank is similarly insulated to minimize heat loss in the supply system, as well as to reduce radiation into the work room. A cold water make up tank is also insulated with blocks to prevent sweating. All circulating and process pumps and lines are insulated with 1½ in. of formed mineral wool.

The insulation is so effective that not only is it true that no line is more than moderately warm, running, by test, under 95 F surface temperature, but heat loss is so slight that comfortable working conditions prevail even on the working platforms located between and above the three boilers. No perceptible temperature increase prevails between the floor and the balcony. The 32 foot ceiling clearance minimizes solar radiation through the roof.

The distribution lines are carried from the balcony level in the power building, directly over the rail spur into the ceiling level of the production floor. Strategically located pressure reducers provide steam at 35 or 40 psi pressure for heating and most process purposes. However, the 140 psi lines allow for the use of dry steam whenever it is needed, without the necessity for control equipment.

Condensate Collection

A centrally located condensate collecting system, operating in conjunction with a large heat exchanger unit, performs a multiple function. The heat exchanger is used to heat the hot water for office temperature control, and for wash water purposes. The decision to use hot water heating in the office building was based on the more readily controlled temperatures which result from the use of hot water, rather than steam. However, it also provided a means of recovering residual heat in end line steam, while at the same time controlling the operation of the condensate recovery tanks. Condensate is returned to the power building by pumps located near the heat exchanger system.

The feedwater for the boilers consists largely of returned condensate. Necessary makeup is added directly from the city mains into the deaerated water storage tank. Daily analyses are made by the plant chemist to insure the correct operation of the water treating system and prevent corrosive scale-forming conditions occurring in the internal water of the boilers.

A. D. Connelly, Plant Engineer for the Salisbury Axle Company and E. H. Roper of A. Bentley and Sons Co., Toledo, were jointly responsible for the exceptional layout which exists there. The performance of the equipment, in the brief time it has been in service, has been almost completely free of leaks or other defects. No indications of scale formation have occurred in the boilers. No insulation breakdown has occurred. No conditions of cracking, sagging, powdering or other mechanical failures in the insulation has been encountered. The continuing fine appearance of the system is partly attributable to the mechanical strength of the mineral wool insulation.

The Corliss Engine that was Bushed

Here is a sad tale of the Corliss engine that was kept away from civilization too long . . . Use of the indicator as a cure-all is deplored by the author . . . Pieces cut off each dashpot rod adjusting screw to give the steam valves as much lap as possible . . . After all was running smoothly the important adjustment measurements were punch marked on the engine

By WILLIAM S. WHITE

AWAY UP HERE in Alberta, west of the highway running north and south between the cities of Calgary and Edmonton, and about 65 miles southwest of Edmonton is a large section of country which is in the process of being logged off for the making of lumber. Clearing of land and farming has followed the sawmills. When one leaves the settled farming parts, he rapidly becomes what is called "bushed" and lost among the tall timber.

From these parts, a great many patients are sent to mental institutions, and it is a common expression if one displays any eccentricities, to say he has been "bushed." Perhaps, then, one should not be amazed at the lack of forethought displayed by those who manage and control sawmills, which from time to time are removed and carried further into the forest and bush as the trees are all cut down within reasonable range of the mill.

A sawmill which had been carried back into fresh timber about 65 miles from the nearest telephone, and 200 miles from the nearest machine shop, had acquired a 16 in. by 30 in. double eccentric Corliss, purchased very much second hand. Without having the engine examined or tested they had taken it to the new site, put in a foundation and set it up, along with a 125 hp HRT boiler, which, strange to say, was very well installed and bricked in and in full accordance with requirements of the Boilers Act of the Province. And as far as the foundation of the engine was concerned, a very good job had been made of that, too.

When the new boiler was eventually steamed up, an attempt was made to run the engine, and it was found that the steam pressure could not be held to run the engine alone to say nothing of doing any sawing. It appears that various persons attempted to set the valves on this engine, but with no success. It was then decided that what was needed was an indicator to really achieve something. So, as one of those old fashioned engineers who apparently was the only one in Alberta to have such an instrument, my services were enlisted, and I finally became bushed for seven days, away from any tools or equipment, except for a few small tools I took with me. I had been told, that it was only necessary to indicate and adjust the valves as a final setting.

Great faith seemed to have been built up in the indicator as a cure-all although it should have been obvious that as the engine had not been used for many years, and then left standing, it needed a complete overhaul.

After arriving at the mill we got steam up on the boiler and made an attempt to get some indicator diagrams. But with the strange behavior of the exhaust it was evident that the valve setting would have to be checked mechanically, as the cards that were taken were simply oblong squares. The dashpots worked very erratically. In checking the valve setting, it was found that the steam valves had very little lap with the dashpot closed, and exhaust valves were late. These were set too close at 2 in. from the end of the stroke. After the valve setting adjustments were made the engine was started up and immediately came up to speed until the governor stopped the valves from lifting together. The engine continued to increase in speed, and it was necessary to throttle her to where the hooks would occasionally lift the valves slightly. The cards taken by the indicator showed that steam was leaking badly through the steam valves, and in effect the opening and closing of the exhaust valves kept the engine running without the steam valves opening at all. It was decided to give the steam valves as much lap as reasonably possible when in the closed position.

To do this, ⅛ in. leather washers were removed from the dashpot plungers. A piece had to be cut off each dashpot rod adjusting screw, to enable the rods to be shortened sufficiently. With a lap of ⅜ in. at valve closure another run was taken on the engine and it was found that the head end steam valve had stopped leaking to a large extent, but the crank end valve had not improved visibly. The valve steam bracket assembly was removed, and the valve exposed at both ends. By stretching across and grasping one end of the valve with one hand and the other end with the other hand, it was found that this valve had a decided rock, when held down in its seating position in the bore of the chamber.

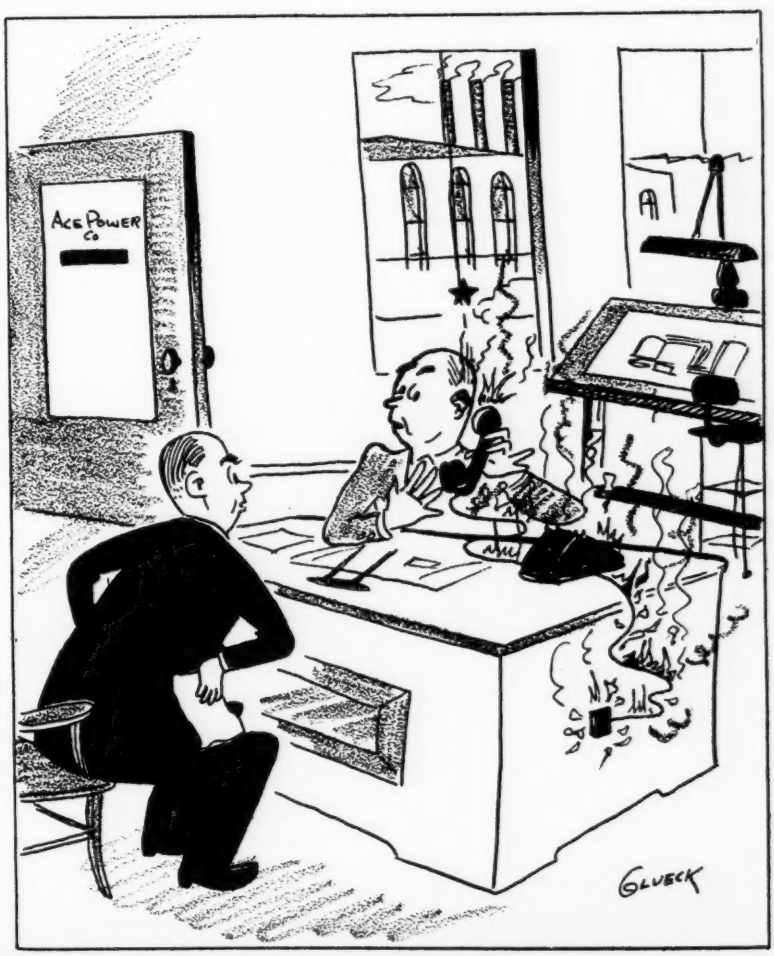
It was evident if the valve did not have the rock taken out across the chamber bore, the steam would not be able to hold it to its seat. The tee head of the valve stem (which was more or less vertical in the valve slot when closed) prevented that end of the valve from seating properly. This problem was solved by making a slacker fit in the valve slot. Care was taken to grind and file it down on one side only. With two pieces of 4 by 6 notched for V blocks, a cradle was made to hold the valve in order to do some filing. Two 12 in. mill files were found to be on hand. With these the valve was filed up lightly all over, so that the cylinder oil with which the valve chamber was wiped out, would visibly mark the surface. After many trials and much filing at the central portion of the valve body the rocking motion was eliminated, and the valve worked down to a seat.

On trial it was found to be leaking no more steam than the head end valve. After a trial run the indicator cards began to show a resemblance to what one may expect from a Corliss engine, but of course, showed very late admission on either end. As trouble was being had with the proper working of the dashpot on the crankend, the plunger had to be tightened in its cylinder. On the vacuum plunger three grooves had originally been turned to carry oil and help to seal against air leakage. With some rawhide belt lacing, pieces were cut to act as rings set in these grooves. The entrance edge of the cylinder was chamfered off with a file, to give the leather packing a start, and the plunger with packing forced home. With the aid of an eight foot length of 2 in. pipe, a piece of chain, and the dashpot bolted back on its base on the engine bed, sufficient leverage was obtained to work the piston back and forth until it loosened up. After connecting up the dashpot assembly, the engine was run slowly, and one of the employes of the mill stood on the dashpot plunger with one foot riding it up and down until it finally was able to close the valve with a snap. With the curing of the lazy dashpot, a few trials and errors on the steam eccentric, and some slight adjustment on the reach rods from the wrist plate to the valve hooks, a very reasonable card was obtained with the indicator. Some adjustments on the governor rods helped some and the engine on no load was only occasionally breaking the steam valve edges. One, of course, has to keep in mind that the valves leaked steam.

The next thing was to get the mill under way and start sawing. Under the load the engine behaved well, and it was evident that there would be no difficulty in providing steam. Finally, after the trial run of the mill was finished, all important adjustments were tram marked with dividers and the measurements were punch marked on the engine for future reference. The original shop marks had been altered during this engine's lifetime, and many other mysterious marks substituted.

While a good foundation had been put under the engine, it was installed very awkwardly, with the throttle valve hand wheel on the opposite side from the wrist plates. The belt from the flywheel to line shaft passed with just sufficient space between it and the valve gear to allow the engineer to operate the valve gear by hand. As it was not possible to have placed the engine on the other side of the line shaft the engine should have been turned around, and the valve setting changed. While the Boiler's Act of the Province does stipulate that certain conditions be observed (sometimes) in the installation of boilers, it fails to provide for approval of anything else pertaining to steam plants. The Act, however, distantly states that for the purpose of the Act, "boilers" shall mean all the apparatus connected with the boilers and deriving steam from them. It is apparent in a great many cases, that the present way the Boilers Act is being administered it fails to provide competent engineers, to enable the purposes of the Act to be carried out, and fails in itself in seeing that installations are made with reasonable engineering precautions.

SLIP STREAMS of hot oil channeled through pipe systems have been used to heat refinery buildings where no steam is available for the purpose. The oil may be returned to the plant line at any point where the pressure is less than that of the point where takeoff was made.



"Apparently they don't care for our suggestion in engineering——."

Practical Applications of the Mollier Diagram—III

Characteristic of the Reheat Water Cycle

By WALTER HEIDECKER

POWER PLANT OPERATORS found that with practical temperatures limited to 750 F, the increased range of expansion for initial pressures over 400 psia caused the steam to become saturated too soon to permit the lower stages of the turbine to function efficiently. The practical method of correcting a condition of this kind would be to heat the steam after it was partially expanded in a high pressure turbine, and then complete the expansion in a low pressure unit. Figure 1 is a diagram of a power plant in which low pressure steam is reheated by returning it to a superheater in the steam generator, the source of heat being flue gas.

Plotting the condition lines of the equipment, Fig. 1, on a Mollier's, we get the characteristic diagram of the reheat water cycle. It is of interest to note that the diagram, like the Gaul of Caesar's time, is divided into 3 parts; superheated steam section, supersaturated steam section (shaded area), and wet steam.

Supersaturated steam is a phenomenon of steam in motion and occurs in the steam passages in the turbine. The pressure drops faster than the vapor can be transformed into water and the heat of vaporization be given up to the surrounding steam.

Supersaturated steam has very nearly the same qualities as superheated steam. The upper limit of this region is definitely the saturation line of Mollier's Diagram. The lower edge of this region cannot be defined clearly. For pressures below 40 psia, John I. Yellott, Jr., in his paper "Supersaturated Steam" (in nozzles) Trans. ASME FSP 56-57 page 411 June 1934, recommended a line running parallel to the saturation line between the 3 per cent and 4 per cent moisture lines. Some authorities are of the opinion that the steam remains more or less supersaturated as it whizzes through the last stages of the turbine into the condenser.

The idea of reheating steam in a superheater was never popular commercially. The disadvantage of this arrangement was the large piping to and from the boiler and in the second superheater. Instead, a "reheat" boiler was used between the turbines. The source of heat was live steam from the header.

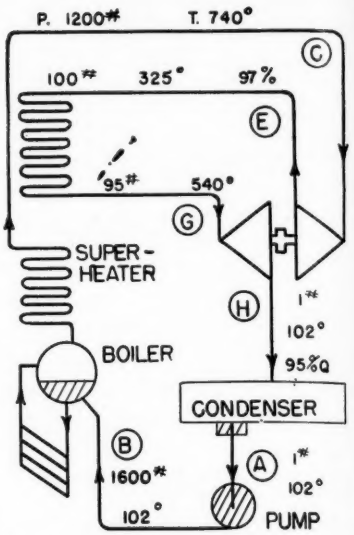


Fig. 1. Diagram of a power plant in which low pressure steam is reheated by returning it to a superheater in the steam generator

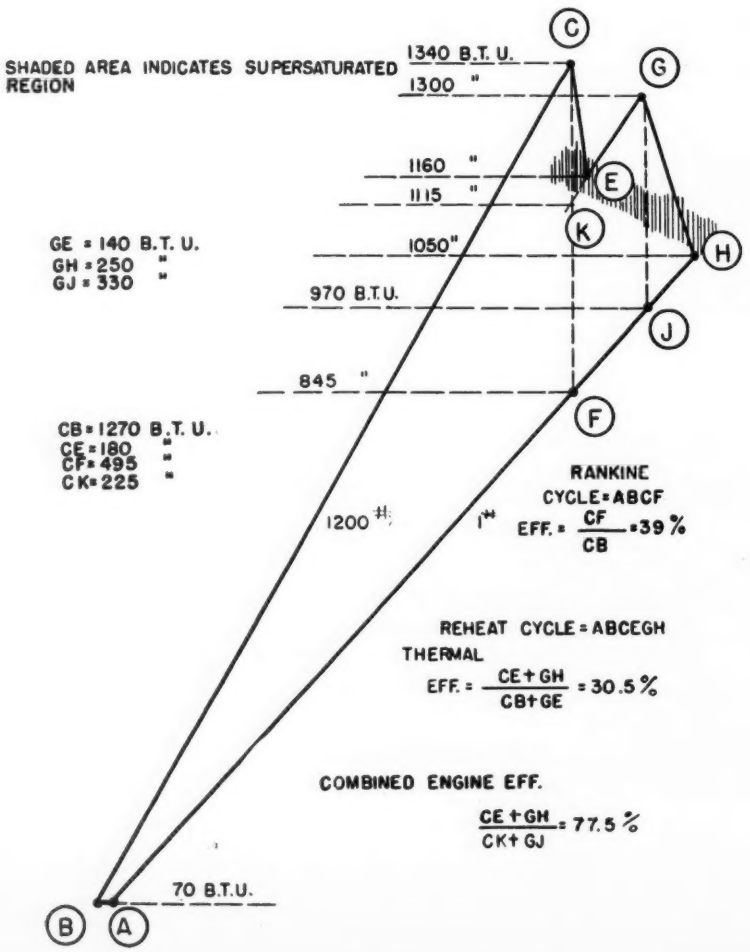


Fig. 2. The Characteristic Reheat Water Cycle

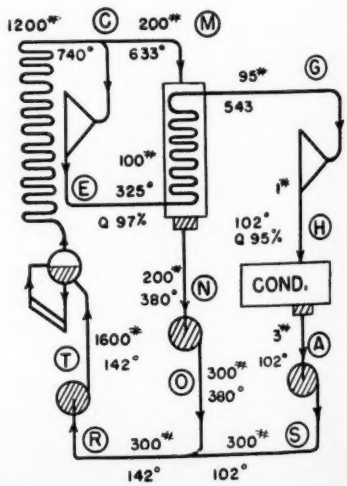


Fig. 3. Diagram of a power plant using a reheat boiler

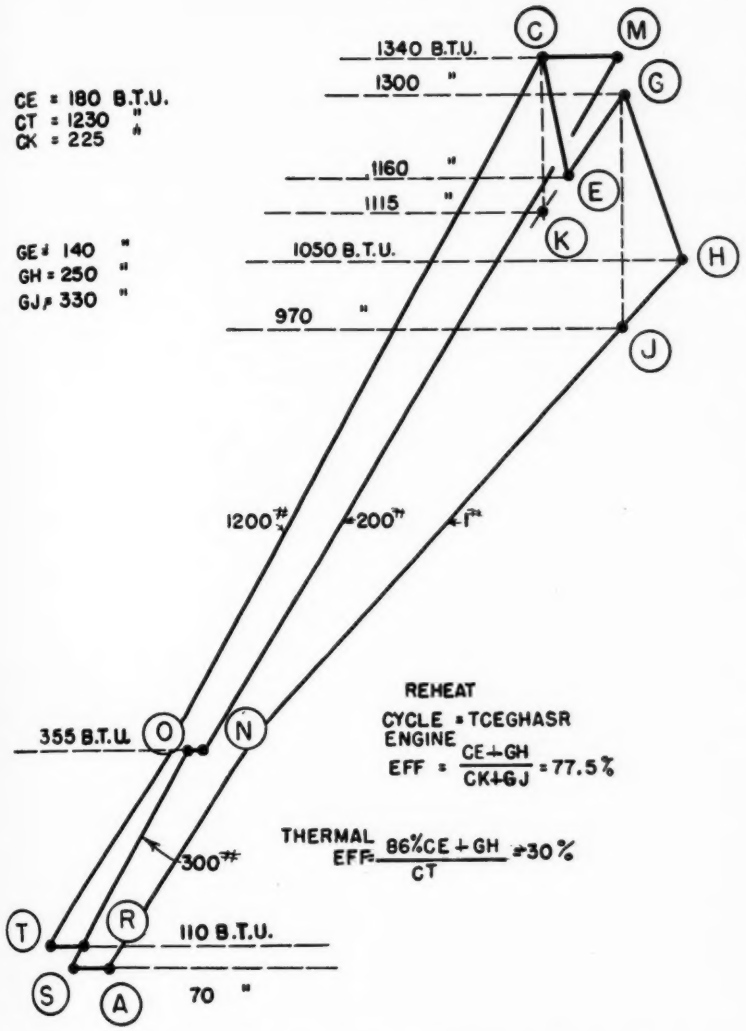


Fig. 4. Characteristic cycle diagram of plant represented by Fig. 3.

Figure 3 is a diagram of a power plant using a reheat boiler. Note that the steam flow divides at C, 86 per cent passing through the turbines to the main condenser and 14 per cent passing into the reheat boiler where it is condensed, and the liquid pumped back into the feedwater pipe going to the boiler. The steam to the reheat boiler is shown throttled down to 200 lb for convenience in constructing the cycle diagram Fig. 4. The flow of condensate from the condenser through the condensate pump is represented by the line "AS" and the drainage from the reheat boiler through its pump by "NO." As these pumps discharge into a common header, the pipe contains water having two different temperatures, this is represented by the line "OS." The water is mixed in the pipe and the resultant heat content is the sum of the individual streams.

14% × 355 Btu = 49.7 Btu from the reheat boiler

86% × 70 Btu = 60.3 Btu from the condenser

60.3 Btu + 49.7 Btu = 110 Btu the combined heat content of the feedwater going to the boiler and is represented on the diagram, Fig. 4 by "R." The passage through the boiler feed pump is "RT," "T" being the beginning of the condition line of the boiler.

The lower part of the diagram below "NO" has been "blown sideways" to illustrate the actual points around the pumps, Fig. 3.

ACCORDING to an official of a major oil company, the present investment per daily barrel of refined petroleum products has increased since 1939 from $900 to $1,500 for crude topping and catalytic cracking plants; from $600 to $1,000 for crude topping and thermal cracking; from $180 to $300 for skimming plants; from $2,100 to $3,500 for synthetic oil from natural gas, and from $3,000 to $5,500 for synthetic oil from coal.

STEAM VELOCITY CHART

FOR STEAM piping certain velocities are recommended for several classes of service. Where the flow is steady, the high velocities may be employed. With reciprocating steam machinery, where the flow is pulsating, lower velocities are required. Higher velocities are permitted with superheated steam than with saturated steam.

Recommended Velocities

Boiler Leads....
6,000 - 12,000-feet per min.
Steam Engines and Pumps—
Steam and Exhaust....
6,000 - 9,000-feet per min.
Steam Turbines—Steam and Exhaust....
9,000 - 15,000-feet per min.
Main and Auxiliary Headers....
Auxiliary Steam and Exhaust Lines....
6,000 - 12,000-feet per min.

Formula

$G = 0.005454\ W\ D^2\ V$

G = Pounds of Steam per Minute
W = $1/V_s$ Weight of Steam per Cubic Foot
D = Internal Pipe Diameter —Inches
V = Velocity—Feet per Minute
V_s = Cubic Feet of Steam per Pound

How to Use the Chart on Page 100

EXAMPLE: What is the velocity of 2000 pounds of saturated steam at 400 psi absolute flowing through an 8-inch internal diameter pipe?

SOLUTION: Draw line A-B joining 2000-lbs on the quantity scale and 400-lbs on the pressure scale which intersects the X-X axis at 0.

Draw C-D from 8-inch on the diameter scale through O which, prolonged, intersects the velocity scale at 7000-feet per minute.

Superheated steam problems require the use of volume scale instead of pressure scale. Refer to steam tables for the volume of superheated steam at the desired pressure.

WOOD DECAY SURVEY LAUNCHED

A STATE-WIDE study of the factors influencing wood decay, under conditions of modern construction, has been initiated by the New York State College of Forestry at Syracuse University. The study will be done under the direction of Dr. Ray R. Hirt.

Dr. Hirt states that the cooperation of architects, contractors and builders of New York state will be sought in order that the results may be of the greatest practical benefit to the public.

The project will include the study of wood decay in year-around dwellings, summer homes, storage plants, office and industrial buildings, and other types of wooden structures. The problem of modern wood preservatives in relation to the control of decay in new lumber as well as in timbers already in service, will form an important part of the investigation.

The "Why" of Bimetal Thermometers

Early research proved that bimaterials other than metals were subject to too great errors . . . Development of nickel alloys made possible the present bimetal instrument . . . Method of combining the two metal strips . . . Thermal and mechanical precautions . . . Heating and rolling . . . Advantages of the helix and multi-helix

By A. H. LAMB, Chief, Relay & Thermometer Engineering Div., Weston Electrical Instrument Corp.

EARLY bi-material thermal elements consisted of very crude devices such as a strip of hard ruber, and even wood, riveted, cemented or screwed to a strip of brass or iron. The resultant errors were very large and the indications were not reproducible, in fact, early bi-material thermometers were almost as responsive to humidity and other variables as to thermal changes.

It was soon realized that only materials of a tough, resilient and non-hygroscopic nature would offer any possibility of success; such material could only be a bimetal; and all work with bimaterials other than metallic was quickly discarded.

About this time remarkable developments were taking place in the nickel alloy field and one new alloy offered great hope for bi-metallic thermal elements. At normal atmospheric temperatures this alloy neither expanded nor contracted, its length was invariable, hence it received the name "Invar."

Other developments in this field produced a nickel alloy having just the opposite characteristic, that is, a high and consistent rate of expansion under increased temperature and of contraction when the temperature decreased. The effect was reproducible commercially, and constant cycling caused no appreciable "set" or aging. Here at last appeared to be a practical solution, an alloy of negligible expansion and one large and constant expansion, which when welded together and rolled to the proper thickness would bend sufficiently under temperature changes to have a usable sensitivity as a thermometer.

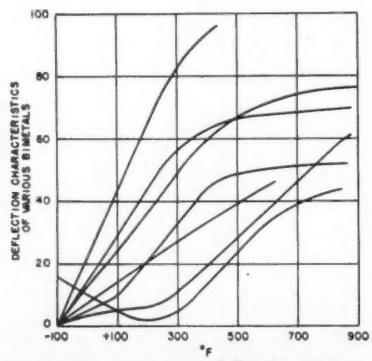


Fig. 1. The temperature-deflection characteristics of various types of bimetals are shown here

Combining the Two Metal Strips

The riveting and other pressure-type joining of the two strips was improved by a direct, high-temperature, high-pressure welded lamination of the two materials in ingot form. Next a series of annealing and roll-down operations are performed until the desired thickness is achieved. By this method the two elements in the final strip of bimetal, no matter how thin, are perfectly bonded and mechanically inseparable and it has the strength of a single piece of similar alloy of equal cross section.

When a straight bimetallic strip, fastened at one end, is heated it bends to form an arc of a circle with the high expansive or "active" metal on the outside and the low expansive or "dead" metal on the inside. This bending or curvature by a suitable mechanical system and scale can be used to indicate temperature. Obviously, the greater the bending effect for a given temperature change, the more sensitive the temperature indication.

Alloys having widely differing coefficients of expansion are welded together for small thermal scale ranges such as 0 to 100 F and alloys of lesser difference of expansion are used for larger scale ranges, such as —100 to + 1000 F.

Usual Thermal and Mechanical Precautions Must Be Considered

Proper selection of alloys must be made with a view to maintaining safe working stresses produced both mechanically and thermally, to provide resistance to vibration, shock, and corrosive conditions; safety against accidental overheating, and a multitude of other conditions met in practical use.

Since a bimetal is simply another method of transforming the energy of heat into mechanical movement, the usual thermal and mechanical precautions must be considered. The bending of the bimetal strip is used to move a pointer tip so that it describes an arc. This work combined with the bending and movement of the strip itself constitutes a mechanical load which must not stress the joined metals beyond their elastic limit. If the elastic limit were exceeded it would cause a loss of accuracy, a permanent set, and general unreliability. Maintaining safe stress limits simply requires a sufficient length of bimetal which, however, presents mechanical problems of winding, support, and spacing, about which more will be mentioned.

Safe Working Stress Values for Typical Bimetals

Temp. °F.	*Lbs./Sq. In.*
—100	25,000
+100	25,000
200	23,000
400	20,000
800	12,000
1,000	7,000
1,200	3,000

There have been developed many different types of bimetals for various temperature ranges and to produce various scale characteristics, usually uniform but on occasion purposely non-uniform and congested over one section of the scale. Imperfectly designed or wrongly used bimetals exhibit surprising characteristics. Even Invar which shows no tendency to expand at normal atmospheric or room temperatures will, at elevated temperatures, expand appreciably and in fact while intended as the "dead" half may become more active than the "live" half thus causing a pointer which is progressing in a clockwise direction as the temperature rises, to slow down and then actually reverse and deflect counterclockwise with still increasing temperature. The temperature-deflection characteristics of various types of bimetals are shown in Fig. 1.

A general rule applying to the selection of a proper bimetal is to use the type which exhibits the greatest uniform activity within the desired temperature range and other requirements which must be met. Most bimetals offer a constant and uniform mechanical detection over a limited thermal range only.

The thermal activity of bimetal has been named *Flexivity* and the American Society for Testing Materials proposed the following method of determining flexivity (F).

The method of test considers the bimetal in an approximately straight strip form, supported near the ends on two knife edges, as shown in Fig. 2. The flexivity is the change in curvature of the center line of the specimen per unit change in temperature per unit thickness.

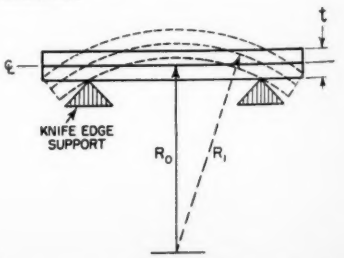


Fig. 2. ASTM test procedure for determining flexivity of bimetals

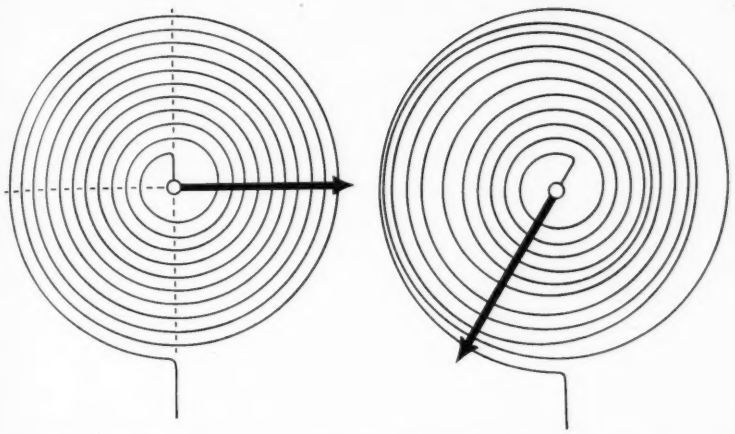


Fig. 3. These drawings show how a spiral, when subjected to a change in temperature, not only rotates the pointer but tends to shift it out of position as the coil changes shape

The formula is as follows:

$$F = \frac{\left(\frac{1}{R_1} - \frac{1}{R_0}\right) t}{T_1 \quad T_0}$$

where F = flexivity

R_1 and R_0 = radius of curvature in inches as shown in Fig. 2

t = thickness in inches

$T_1 - T_0$ = temperature change in F

The deflection or actual movement or activity of a strip of bimetal is proportional to the flexivity. With one end fixed, the end of a straight strip moves or deflects as the square of the length, inversely with the thickness, and in direct proportion to the temperature change, if operating on the straight section of the thermal response or deflection characteristic curve. Thus if the length is doubled the end will deflect four times the distance, and if the thickness is halved the deflection will double.

The angular deflection of a pointer on the end of a helix or spiral changes directly with the length of the strip, inversely as the thickness of the material and again in direct proportion to the temperature change, if operating on the proper section of the thermal curve.

The Bimetal is Heated and Rolled

After determining the characteristics and selecting the proper bimetal material and calculating the required thickness, width and length, the large bar of bimetal is repeatedly heated and rolled until the last rolling produces the correct size and hardness. The strip is then wound into the final helical or spiral form and lastly subjected to various stabilizing thermal treatments in suitable atmospheres. This last series of treatments is at least as important as any other phase in the production of uniform and permanent bimetal elements.

Let us assume we know which bimetal to use, how to heat treat it and how it will perform thermally over the desired range. We must still decide on the stem or housing into which the bimetal element is to be placed and the size and shape of the wound coil which the strip must take to fit into the stem.

Naturally, the stem should have necessary rigidity and strength but be light in weight, small diameter and thin walled. The material must have the proper thermal properties and should not be prohibitively complicated or costly. For laboratory use in checking the temperature of liquids in beakers, test tubes and other small containers a stem diameter near ⅛ in. is ideal. Within this ⅛ in. outside diameter of the stem we must place the walls of the stem, the bimetal element and associated supports, staffs etc. Thus, the coil must be considerably less than ⅛ in. in diameter and it should be as compact as possible in order that correct temperatures can be measured in shallow vessels and at the depth levels desired.

In selecting a bimetal, one was chosen which would not be stressed unduly even under accidental excess temperatures and which for a certain range, turned out to be some 20 in. long, and approximately 0.050 in. wide and 0.005 in. thick. No other combination of dimensions is optimum or will produce exactly the desired results.

To wind the 20 in. strip into a flat spiral coil is the easiest by far but this would produce a flat pancake shape about ¼ in. in diameter, obviously too large. Also, a spiral, when subjected to a change in temperature, not only rotates the pointer but tends to shift it out of position as the coil changes shape. See Fig. 3. This varying side thrust causes considerable pressure against the pointer bearing with resulting errors. The spiral, therefore, is bad from the size standpoint and tends to create variable friction errors. Caution indicates that it would be unsafe to use a bimetal at a higher stress or with a reduced safety factor, as the 20 in. strip was chosen as being the optimum. So let us consider the remaining possibility, a helix. See Fig. 4.

A helical coil overcomes the disadvantage of large diameter as it can readily be wound within the ⅛ in. requirement but now other unfavorable conditions arise. The wound helix becomes quite long and tends to sag in the center and when the helical coil expands and rotates the pointer it also tends to thrust it out away from the scale plate toward the glass and to pull the pointer down when it contracts.

Since best structural rigidity and best mechanical and thermal action can be expected from a coil wherein the necessary length of strip is formed into the smallest over-all size, steps were taken to develop a multi-helix arranged so that two or more helical coils are wound coaxially one within the other. This results in the desired compactness and reduces the end thrust since this effect in the outer coil is cancelled by that in the inner coil . See Fig. 5.

The multiple helices, or "coils within coils," are wound in one continuous piece but do not touch each other along the sides despite the compactness of this arrangement. Since the pitch, or direction, of the winding runs in opposite directions, the tendency for the pointer to be shifted axially and laterally is counterbalanced within the coils. Especially in the instance of greatest sensitivity in shallower depths, this very compact result affords the best over-all temperature measuring arrangement.

This coil-within-coil arrangement is used in most of this company's thermometers and patent rights in the United States are owned exclusively by Weston. Regular production design is therefore dictated only by the best

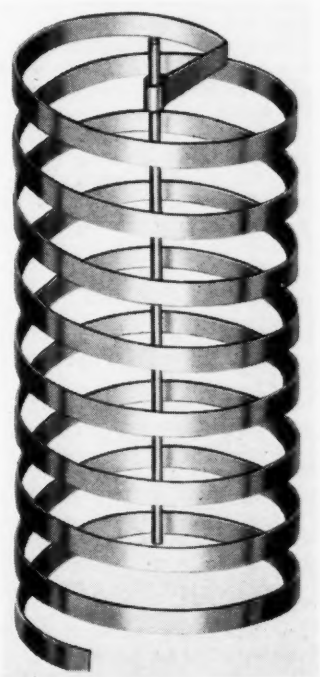


Fig. 4. Shown in this photograph is a simple helix

Fig. 5. Multi-helix arrangement of bimetals results is several advantages

technical practice as to whether a short strip of bimetal wound into a short, single helix or a very long strip wound into four coils-within-coils is used.

We now have progressed from the optimum bimetal to the best form and size of winding. To proceed with the housing; the stem and all of the metal parts, both internal and external, are fabricated of stainless steel which while costly has been found best for general usage. It is little affected by the acids and alkalies with which it comes in contact and it does not contaminate or change the taste of milk and other foods into which it is immersed. Its heat-conducting properties are almost ideal in that the thin wall section transfers the heat quickly to the bimetal measuring element whereas the relatively longer stem section tends to prevent heat loss by transmission along the stem.

The bimetal element is normally anchored at the bottom of the stem and transmits its rotary motion up to the pointer in the head by a straight one-piece stainless steel staff. No gears or levers or other amplifying linkages are required or used.

We now have a complete all-metal thermometer with the exception of the glass window which naturally can be transparent plastic when desired. On seeing such an all-metal thermometer one instantly recognizes its virtual unbreakability and that it has a large, open, easily read and easily understood scale.

REPAIRING A CORRODED BREECHING

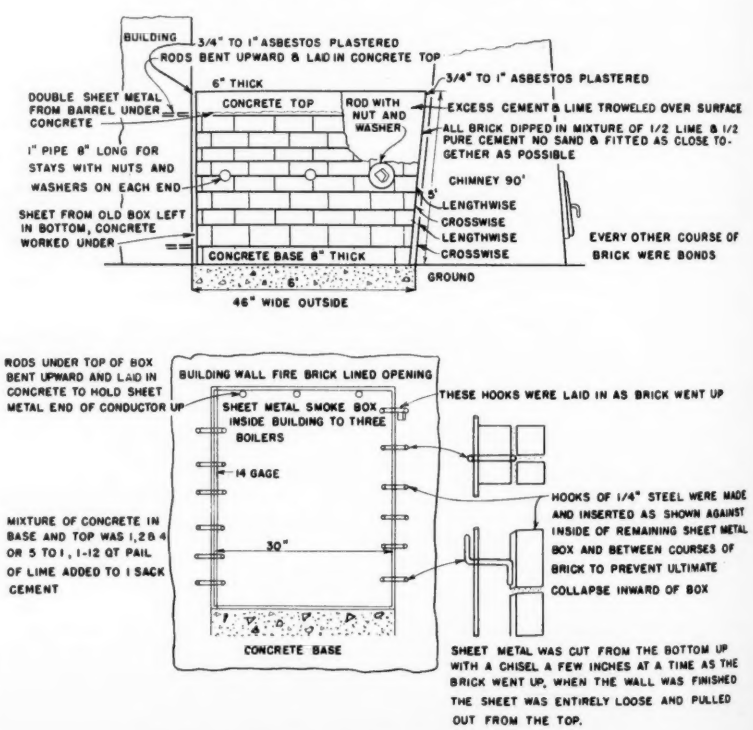
By C. L. Shobe

LATE IN 1941 after almost 6 years of use our breeching, made of 14-gage steel, extending from the building to the chimney failed by corrosion from the inside. The breeching inside the building was still solid. The reason for the failure was apparent. Our fuel controls are set, on with the fire 100 per cent on, or off with the fire out entirely except for pilot lighters. When the load is light the fire is out for a considerable length of time. In severe weather the conductor would cool causing the moisture in the products of combustion to condense, coating the inside with an acid solution which caused corrosion. The entire country was searched for steel of any gage heavy enough to replace it but none was available and there was no time to wait for delivery. We decided that the only solution was brick and concrete construction. We were unable to buy and brick immediately and there was none on hand. We hustled around and dug up curbings from around old walks and flower beds which were made of brick and finally got enough together to do the job. These were a mixture of all sizes and types of brick from the old sun dried building to hard facing and some paving brick.

They were sorted out so as to have the same thickness throughout one course on each side and generally mixed up through the structure in any manner to make use of them. Since there was quite some difference in the various sizes, we did not get such a good job breaking the joints but managed to break them sufficiently.

A concrete base was poured under the remains of the sheet metal breeching and worked under it. Asbestos was plastered against the stack and building to allow for any expansion of the slab before the concrete was run. A foundation, making the slab 6 in. deeper at the edges was provided for making a total of 14 in. The base was made wide enough that a double row of brick could be laid straight up and against the old breeching which was cut loose with a chisel a few inches at a time as the brick went up. Hoops of ¼ in. steel were laid in the brick and extending inside of the good breeching where it was cut flush with the wall of the building to prevent its collapse inwards. The angle iron frame was left and bricked in the opening of the chimney having cut the sheet metal loose from it as the brick went up. Asbestos plaster was used between the brick and chimney also the building as an expansion joint. The dipping mixture was trowled against and over the asbestos while still wet causing it to harden at the surface and it has withstood the weather perfectly. The dipping mixture was trowled all over the entire brickwork improving the appearance somewhat. Already the structure has lasted as long as the original steel and except for a few hair cracks in the material that was trowled on (this was excess mud that was squeezed out from between the bricks) is still in perfect condition and can be given a cement lime wash at any time to fill up the cracks.

We felt that short re-inforcing rods would be better than the longer ones for, as they become hot they have a greater expansion per foot than the


BUILDING
3/4" TO 1" ASBESTOS PLASTERED
RODS BENT UPWARD & LAID IN CONCRETE TOP
6" THICK
3/4" TO 1" ASBESTOS PLASTERED
DOUBLE SHEET METAL FROM BARREL UNDER CONCRETE
CONCRETE TOP
ROD WITH NUT AND WASHER
EXCESS CEMENT & LIME TROWELED OVER SURFACE
ALL BRICK DIPPED IN MIXTURE OF 1/2 LIME & 1/2 PURE CEMENT NO SAND & FITTED AS CLOSE TOGETHER AS POSSIBLE
1" PIPE 8" LONG FOR STAYS WITH NUTS AND WASHERS ON EACH END
CHIMNEY 90'
5'
LENGTHWISE
CROSSWISE
LENGTHWISE
CROSSWISE
SHEET FROM OLD BOX LEFT IN BOTTOM, CONCRETE WORKED UNDER
CONCRETE BASE 8" THICK
EVERY OTHER COURSE OF BRICK WERE BONDS
6'
GROUND
46" WIDE OUTSIDE
RODS UNDER TOP OF BOX BENT UPWARD AND LAID IN CONCRETE TO HOLD SHEET METAL END OF CONDUCTOR UP
BUILDING WALL FIRE BRICK LINED OPENING
THESE HOOKS WERE LAID IN AS BRICK WENT UP
SHEET METAL SMOKE BOX INSIDE BUILDING TO THREE BOILERS
14 GAGE
HOOKS OF 1/4" STEEL WERE MADE AND INSERTED AS SHOWN AGAINST INSIDE OF REMAINING SHEET METAL BOX AND BETWEEN COURSES OF BRICK TO PREVENT ULTIMATE COLLAPSE INWARD OF BOX
MIXTURE OF CONCRETE IN BASE AND TOP WAS 1, 2 & 4 OR 5 TO 1, 1-12 QT PAIL OF LIME ADDED TO 1 SACK CEMENT
30"
CONCRETE BASE
SHEET METAL WAS CUT FROM THE BOTTOM UP WITH A CHISEL A FEW INCHES AT A TIME AS THE BRICK WENT UP, WHEN THE WALL WAS FINISHED THE SHEET WAS ENTIRELY LOOSE AND PULLED OUT FROM THE TOP.

Sketch showing how corroded breeching was repaired

concrete. Hence a long rod might cause strains that would break the slab. Rods of about 2 ft in length were laid to overlap at the ends and so far, we have not found a break in the 46 in. by 5 ft slab on top. We do not know the temperature of the gas in the structure but the flue gas at the damper is 350 F. A double thickness of sheet metal from oil drums was placed over the brick work to pour the concrete top on. These sheets were held apart by length of ½ in. rods to provide a space for dead air, thus protecting the slab from the heat to a certain extent.

The cost of the structure was small as the work was done by 2 men in 3 days. The half-and-half lime-cement mixture is nice to use since once it is mixed it does not settle out and harden. It is mixed much easier by pouring the dry materials into water. A dip box 12 in. by 24 in. by 4 in. deep was used.

TUBE ROLLING

WE HAVE a fairly small plant so, when we re-tube our boilers we have to get by with a minimum of help. The enclosed sketch shows the arrangement of the tubes and drums.

To begin with, we seldom find that the tubes, as received from the factory, are exactly correct in length; they may be 1 in. too long or too short. The factory measurement is made around the outside curve (as shown in the sketch) and this is the measurement which determines what you pay. When received, they may have been sprung in shipment or they may have changed after being cut at the factory.

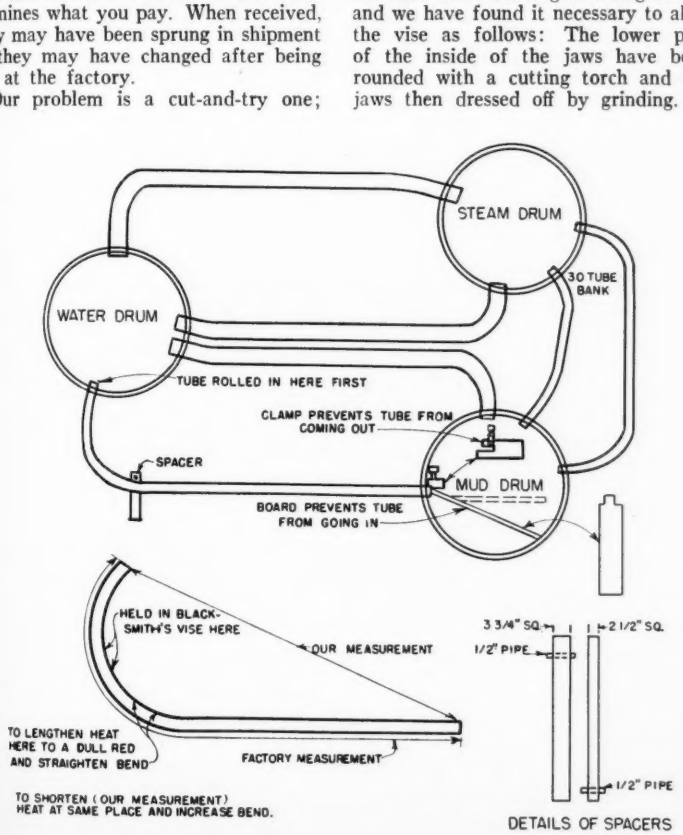
Our problem is a cut-and-try one; we must bend and re-bend one of the tubes until it is the right length. We allow ⅜ in. of the tube to extend into the drum (plus or minus ⅛ in.). After getting one which is the right length it is measured as shown (our measurement) across the ends and every tube in that row is made to this same measurement. The heating is done in an ordinary forge with coal.

The tube is inserted in the drums and a clamp, which is slotted back ¾ in. and fitted with a set screw, is placed on the straight end of the tube in the mud drum. This clamp is made from 1 in. by ½ in. rectangular steel and is about 2½ in. long. Then a board, 1 in. by 4 in., which is loose inside the drum when held horizontally as shown by dotted lines in the sketch, is notched in such a manner that the end will enter the tube. This is then inserted in the tube and the free end allowed to drop and rest on the bottom of the drum.

In one row of tubes the tubes are 2½ in. apart and in the alternate row they are 3¾ in. apart. The spacers shown in the sketch are placed between the tube being rolled and the adjacent tube at a point near the curve. When using the tube expander it is first used in the water drum making certain that the twisting movement causes the tube being rolled to bear upon the spacer which is held securely in place by the adjoining tube.

A blacksmith's vise is used to hold the tube while bending or straightening and we have found it necessary to alter the vise as follows: The lower part of the inside of the jaws have been rounded with a cutting torch and the jaws then dressed off by grinding. A curved shoe with the curve made to correspond to the curve in the tubing is fitted over the vise screw to prevent denting the tube at this point.

It requires a minimum of three men to carry on the work efficiently. One man works in the drum, another on the fire side of the drum and the third sets the clamps and boards and is free to carry tubes.


STEAM DRUM
30 TUBE BANK
WATER DRUM
TUBE ROLLED IN HERE FIRST
CLAMP PREVENTS TUBE FROM COMING OUT
SPACER
MUD DRUM
BOARD PREVENTS TUBE FROM GOING IN
HELD IN BLACK-SMITH'S VISE HERE
OUR MEASUREMENT
3 3/4" SQ.
2 1/2" SQ.
1/2" PIPE
TO LENGTHEN HEAT HERE TO A DULL RED AND STRAIGHTEN BEND
FACTORY MEASUREMENT
1/2" PIPE
TO SHORTEN (OUR MEASUREMENT) HEAT AT SAME PLACE AND INCREASE BEND.
DETAILS OF SPACERS

TUBE CLEANING HOSE

By "Fourteen"

TUBE CLEANING hose should be treated with care and respect. There is a lot of good money wound into those coils.

The first step in caring for the hose starts with breaking it out of the package. Uncoil the hose and stretch it out its full length in a cool dry room, this will permit the strains to normalize after being packaged for an unknown length of time. Twenty-four to forty-eight hours in this position will help.

The second step is a procedure that should be followed throughout the entire life of hose. Using two wrenches (don't use that pipe wrench) which fit the flats snugly, tighten the hose couplings. Close inspection will show that the couplings lock the ends of the protective wire and must have a firm grip on the end of the hose to be safe. Each time hose is taken out for use the couplings should be inspected. A loose coupling is a definite hazard to operating personnel and will quickly chew the ends of the hose resulting in tube cleaner shut-down and costly repairs.

Drilled plugs or caps (for ventilation) screwed into the couplings when stored will protect the threads and keep dust and foreign objects from getting into the hose.

When a hose is being prepared for storage it should be stretched its full length and vigorously blown with air to clear out all surplus oil. Coil the hose in the largest coils storage space will permit and lay coiled hose on a flat surface. Standing on edge or hanging coiled hose should positively be avoided. The maximum life of a hose can be obtained by storing the hose in a trough, which supports the hose its entire length and has a slight gradient which permits oil to drain from the tube. Just as damaging to the hose as kinks are heat, moisture and sunlight. Special care should be exercised to store tube cleaning hose in a cool and dry atmosphere.

Before a tube cleaning hose is screwed into a motor it should be strongly blown with air and with the lubricator feeding oil into the air stream. This will insure oil reaching the motor immediately upon starting. A shot of oil into the tail end of the motor will also help in eliminating starting wear.

The fact that tube cleaning hoses do not have moving parts unfortunately causes them to be put in a category of equipment which require little or no attention. This attitude is costing tube cleaner users thousands of dollars and

longer down time of essential equipment each year. Excessive pressure drops through the hoses lead to lower motor speeds dulled or burned drills or cones and more time per foot of tube cleaned.

A wise operator realizes his tube cleaning equipment is no better than the hose he uses and hence he takes care and pride in protecting the cleaning efficiency by giving the hose special attention.

PRACTICAL HINTS AND KINKS

PRESERVING COPPER PLATING IN REFRIGERATING COMPRESSORS

By W. E. Warner

IN REFRIGERATING plants charged with methyl chlorine it has been found that copper may be dissolved by the lubricating oil. This copper deposits out on other parts of the compressor, while in most cases the deposit formed is insufficient to cause trouble, it can, however, be sufficient to cause heating at the bearings and stiff operation of the valves. It, of course, causes wastage of the copper lubricating oil pipes in the compressor. This action is a form of electrolytic corrosion. It is improperly understood, but it is known that one of the main factors is the oil used.

The oil used should be free from any tendency to oxidize readily and be free from unstrained hydrocarbons. Heat, moisture, and air, are favorable to oxidation and should therefore be avoided. Regular changing of the lubricating oil used and the cleanliness of the interior of the compressor will go far to combat this trouble.

HARD FACING SAVES DOWN-TIME OF PULVERIZERS

A POWER plant in a major industrial area uses several Raymond type mills. In each mill two plows revolving inside the crusher casing throw the coal in front of the rolls. Pyrites and other abrasives in the coal wear out ordinary steel plows in about four weeks, so that in early operations it was necessary once a month to shut down the entire mill while replacements were made.

The two badly worn plows shown in the illustration are from a fifteen ton mill. They were protected on the wearing areas with 3/16 in. coated Stoody Borod and in contrast to the usual 4 weeks life, lasted over 28 weeks. The power plant referred to now makes a practice of applying Borod to all its plows before they are placed in service. The hard metal is again applied before the plows are so badly worn they need building up.

In applying coated Borod no preheat is necessary, although it is advisable to skip-weld on several plows to avoid over-heating.

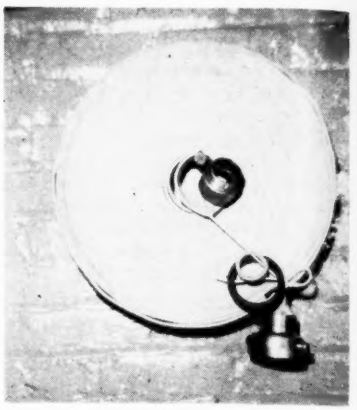
As an experiment on the same Raymond mills, 3/16 in. Borod was applied to the lower end of the journal housings. Ordinarily these housings would last only ten months, but to date the hard-faced housings have run over 20 months and show no signs of wear. *"Fusion Facts"*

These two plows, though badly worn, have lasted more than 28 weeks in contrast to the usual four

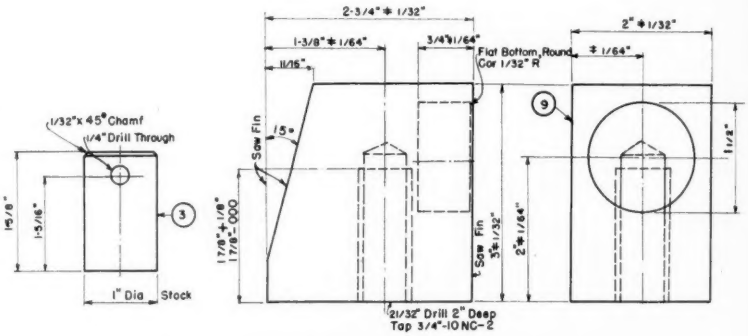
SPARE FIRE HOSE

By THOMAS TRAIL

A LARGE HOTEL takes the precaution of keeping a new spare length of fire hose on hand in the engineers' quarters in case of emergency. Whenever a fire occurs in any part of the building, this coil of hose can easily be



taken to the scene of the fire, where it can be used to replace a leaking or burst hose, or to serve as an extension length of hose. Coupling and nozzle washers are attached to the coil of hose to replace any damaged or missing washers at the fire location.



ITEM	DRWG NO	QUANT	MATERIAL	DESCRIPTION
1		1	Mild Bar Steel ASTM A107 1020	Draw Bar
2		1	" " "	Pin Plate 1/2"x 4"x 12"
3		1	Mild CF Stl Rd ASTM A108 Steel	Pin for Coupling
4		1		Plain Washer I Std
5		1	"	Cotter Pin 1/4"x 1-1/2" (#4)
6		1	"	Hex Hd Bolt 3/4"10 NC x 3-1/2" Length
7		1	"	Hex Nut 3/4"-10 NC-2 Std
8		1	"	Cotter Pin 11/64" Dia x 1/2" (#8)
9		1	Mild Bar Steel ASTM A107 1020	Bumper Block
10		1	Med Rubber	Bumper - Std 1/2" Dia - Stopper
11		1	Steel	Hx Hd Cap Scr 3/4" 10NC x 3-1/2"
12		1	Spring Steel	Lock Washer 3/4" Size

Details of Rubber Shock Absorber

SHOCK ABSORBERS ON MONOTRACTOR LOAD BAR

TROLLEY MOUNTED elevators are both indispensable and efficient about plants where many parts or assemblies are moved through the production line. Since there is much cast iron used in the construction of both the tractor and trolley load bar or suspension system it

has proven a worth while move to install rubber bumpers on the extremities of these units to better withstand the collisions that occur through the careless handling by personnel.

The rubber used is nothing more than a large rubber stopper used by chemists and forced in to the recess provided by means of a press fit. The installation was made simply by reason of the fact that a draw bar pin (not used) was easily withdrawn and mounting bolt for the shock absorber mounted in its stead.

LETTERS AND COMMENTS

CHOICE OF CHIEF ENGINEER IMPORTANT TO ALL

Many articles have been published in POWER PLANT ENGINEERING, showing a regrettable lack of organization and general efficiency in certain power plants. In these articles, management is held responsible for these unfortunate conditions. Truly, in the opinion of this writer, management IS TO BLAME.

One of management's most obvious errors is the appointing of a man as Chief Engineer, or Superintendent of Power, or whatever may be the title, simply because he may be a good mechanic. Management, it seems, is blind to the fact that while an engineer may be a mechanic, it does not necessarily follow that a mechanic will be an engineer. Really, an engineer is a graduated mechanic.

Management seems to think that all one needs to know to be an engineer is a working knowledge of a spanner; and the ability to get thoroughly dirty. Thus, it of course follows that management will have little respect for the man it chooses to fill the responsible position.

What any Superintendent of Power, or his equivalent, really needs, in the way of mental equipment, is a knowledge of the fundamentals of the sciences, and a thorough grounding in basic psychology. This last item is what we would like to stress in the present writing.

Nothing could be more important to any executive than to know men, than to be able to judge their ability, understand their little whims and fancies, see their capacity, and then have, himself, the ability, (and authority) to fit them into their proper niches.

There is a certain principle which we may call the "Psychology of Individual Development." It is the duty of the executive engineer to know of the existence of this principle, and how it applies to the men on his staff. To apply the principle the engineer must know the racial, religious, family, and educational background of his staff members. This implies a very human, Christian character on the part of the engineer, so often lacking. I have only seen it once, in 25 years.

We have observed, through a quarter of a century, a number of "engineers" who will, roughly, fall into the category of one of the following types.

We note, first, the Great Dictator. No one on his staff can possibly be allowed to know anything. No one is allowed to express himself, endeavour to improve the plant, or to progress. And, of course, ridicule and sarcasm being the weapons of weakness they are used extensively against the staff members, in order to enhance the prestige of the engineer. Informers are encouraged, and pushed over the heads of the more competent members of the organization. Books, periodicals, journals, as well as experienced and informed members of the profession are scorned. The mechanical condition of the plant in the dictator's charge reflects in full the character of the "engineer." From this spectacle of arrogance we go to—

The weak sister. Just how he got the position no one seems to know, or at least, will say. With little knowledge of the duties of the position, and less of the men, he cannot make the slightest decision, lest he err. He is incapable of giving an order, so the men run over him. Staff morale hits a new low, and of course, the condition of the plant is unspeakable.

The third member of our interesting trio is of different stripe. Recognizing the fact that each of his men is a human being, appearances and actions sometimes to the contrary, he makes a study of the individual, and makes use of the results of his survey in humanity. He knows that a complete knowledge of the details of every trade, by one person, is impossible, he confines himself to a general study, and leaves the details to those doing the actual work.

He is not chary of praise, when warranted, and thus builds a spirit of confidence and interest in his staff. He delegates as much responsibility as he can to others, thus not only aiding his staff to develop, but as an additional gain, he has more time in which to study the broader phases of his work. He fosters, by fair and judicious means, a competitive spirit among the men, thus bringing forth a flow of ideas and plans that will add to the general efficiency of the organization.

Always recognizing that there is dignity in necessary labor, he belittles no job in the plant. He knows that the work is necessary, or the position would not exist.

He spends as much time as possible in assisting in the development of the staff members, remembering that a general can only be as good as is his army. He knows, that, as the leader of a crack staff, his own prestige will be enhanced.

Naturally, the division between the types is not as sharply defined as above, but we hope that the general idea is clear. And, until management realizes exactly what an engineer is, management will pay the bill.

WHY CAN'T META-PHYSICAL SCIENCES KEEP UP WITH PHYSICAL SCIENCES

AS REGARDS the lag between science and engineering and psychology and socially I think that our educational system is basically at fault. We teach the system whereby greed and avarice are enhanced characteristics, and the more open hearted ideals of a real person are scorned.

It is thoroughly disheartening to observe a graduate engineer flaunting his sheepskin like a banner of war, and at the same time be so crude and ignorant of the very basic needs of humanity. To my humble mind, that sheepskin, should be a cloak of labor.

What is to hinder us from giving our children a full and rounded knowledge, a knowledge, not only of the physical sciences, but the metaphysical as well? Our only hindrance is a backward, dull, and reactionary public mind. A large order, isn't it? What can we do to overcome this obstacle? Start at home with our own family, and the neighbors if possible. Gather round a microscope, a pond, a tree, gently point out that all flora and fauna are related, are interdependent. That to survive, the human species must recognize no race, creed or color.

Yes, education begins at birth, and we, the parents are responsible. One severe handicap that we must overcome is the type of elementary school teacher that we often encounter. The type that believes that her only duty is to "impart her knowledge." And of course, the children must not think.

As for the adults, the case seems hopeless, but let's not despair. It is not pleasant to observe an MD and those who should know better ridiculing psychology and psychiatry. True, the last two are not as yet reduced to a science, perhaps because it is only of late years that much thought has been given to them.

As for the physical scientist who scorns psychology, let me point out that it is easily possible that thought patterns are a very substantial physical entity. Indeed, it would seem strange to me if they were not. The possibilities are tremendous.

SAM WILLIAMS

Questions And Answers

Answer No. 360

CAN HE GET MORE POWER BY BALANCING UP 3-PHASE LIGHTING CIRCUITS

von Dannenberg Comments on Dean Hvidsten's Answer

THE ANSWER shows an arrangement for obtaining 1-phase current from a 3-phase bank by means of a reversed connection, on the secondary side, in the leads of one transformer.

This arrangement may serve for an emergency but should be avoided as a permanent one, in preference to a standard 3-phase delta connected secondary grouping for reasons as follows:

1. The relative bank capacities are, theoretically, 3 to 1.33 and for a practical application 3 to 2 for three units of equal capacity.

2. The relative regulation for the same loading is 2 to 1.

3. The arrangement as suggested can deliver 1-phase current only against both 1-phase and 3-phase for the standard delta connection.

4. The loss of one unit with the, suggested connection, makes the bank useless while with the standard connection operation at reduced capacity can be maintained with an open delta arrangement for both 1-phase and 3-phase current.

It can readily be appreciated how such an apparently simple arrangement leads to most undesirable results particularly from the standpoint of expense and operation.

C. O. VON DANNENBERG
Brooklyn, N. Y.

Answer No. 375

CAN FURTHER ADJUSTMENTS BE MADE ON THIS ENGINE?

INDICATOR DIAGRAMS were given in the April issue, from a 20 by 42 in. 79 rpm double-eccentric, Harris Corliss steam engine. This engine, operating beaters and jordans in a paper mill, was not able to carry the load. O. H. D. showed cards taken before and after adjustments were made on the valve gear and asked what more could be done.

Comments by Emerson

On this type of engine my suggestions are as follows: First, figure the horsepower of the engine and that being developed, this will tell whether the engine is overloaded or not. If not, further adjustments may be made on the valves. The valves should be set for long range on a double eccentric engine when the load is greater than can be carried with normal setting.

Lap is the amount the valve overlaps the port when the valve is closed. This lap is put on the steam valve to hold it closed during the compression period and until it is desired to admit live steam to the cylinder. The lap is usually 1/64 in. for each inch of cylinder diameter.

Range of cut-off is the distance the piston has traveled in its stroke where it is controlled by the action of the governor. From the indicator card, Fig. 3, I would say the cut-off was taking place at about ½ stroke, which may not be enough for the load.

The range of cut-off may be increased by setting the eccentric back 90 deg and further by shortening the steam valve rods so that there would be negative lap. In other words, the valves would open when the wrist plate was in its mid-position. This further increases the range of cut-off beyond ½ stroke.

One thing must be remembered: the valve must trip at its extreme range. If it does not, steam will blow through the exhaust valve, for the engine will then be like a plain slide valve engine: that is, the valve, if not tripped, will hang on and take steam full stroke.

To offset this difficulty, the governor is blocked in such a position that in its lowest blocked position, as in starting up, it will cut-off.

The valves in general are set the same as in the single eccentric engine, all marks being verified.

The exhaust eccentric is set by placing the piston at about ⅞ stroke and advancing the exhaust eccentric until the valve on the end the piston is approaching is just beginning to close. Repeat the operation on the opposite end. Make both ends as near alike as possible.

To sum up:

Put the piston at the end of the range desired and advance the eccentric to its extreme forward position and fasten. Put the piston on dead center and shorten the rights and lefts from the wrist plate until the desired lead is obtained.

The range of cut-off is important. The governor must have movement enough to set the trip for the full distance provided by the range of cut-off due to the position of the eccentric. For example: If the range is ⅝ stroke due to the eccentric and the cut-off took place at ⅜ stroke by the governor being in its lowest position, the engine could not develop its full power.

CHESTER V. EMERSON
West Roxbury, Mass.

Comments from Goldsmith

Since OHD has a double eccentric Corliss engine, he can increase the cut-off and possibly carry the load. The increased steam consumption which will result from running with a late cut-off will probably not be an economic factor in his case, for he undoubtedly can use all the exhaust steam he can get. The valves should be set as follows:

The valve gear, rocker arms, wrist plates, and eccentric rods are all set for equal travel in the usual manner. With both eccentrices on center marks, set all vales line and line. Move piston to point of stroke where you want compression to occur.

Then advance the exhaust eccentric until the exhaust valve on that end closes. Now put the engine on dead center and retard the steam eccentric to get a late cut-off; 45 deg will give about three-quarter cut-off. Take the lap off the valve with the right and left adjustments until the desired lead is obtained. Be sure the governor trips the steam valves, otherwise both valves will be open at the same time. This precaution must always be observed when cut-off is increased to more than one-half stroke.

R. B. GOLDSMITH, JR.
Beverly, Mass.

Answer No. 377

HOW MAKE FORCED DRAFT AIR FOLLOW FUEL FEED?

Comments by Moulton

THE BEST remedy, of course, would be to replace the geared motor damper control with a more efficient and accurate hydraulic or pneumatic damper control, actuated by steam pressure changes, sensitive to small pressure change—any one of several makes now on the market.

But since E. E. wants to use his present equipment, but to make it quicker acting in opening and closing, there seem to be two ways in which it can be done.

First, replace the present motor with one of higher speed; second, change the crank wheel to a cam wheel either by attaching a cam disk to crank wheel or by replacing it with a special cam wheel made to suit conditions.

Now the present arrangement as I understand it, produces rather slow motion. But as the motor is only 1/20 hp and has torque of only 50 ft-lb, it probably could not handle the damp-

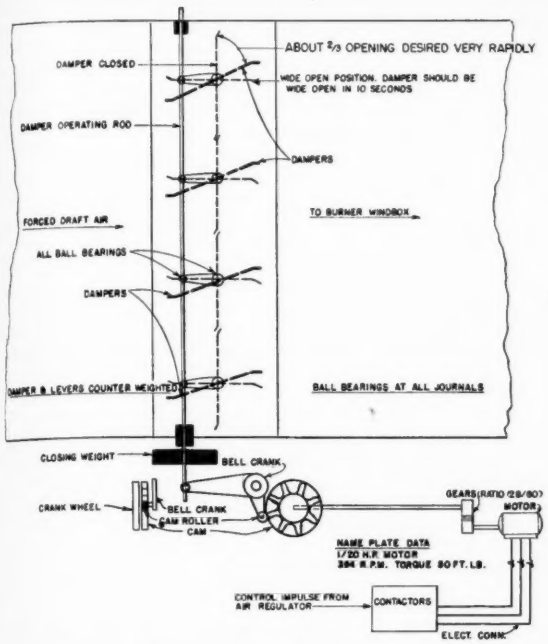


Diagram by Albert H. Moulton, showing his suggestion for operating E. E.'s dampers through a special 8-pointed cam

er on direct drive. Taking all this into consideration it seems that the simplest and most satisfactory mechanism — one that would be reliable and most trouble-free—would be an 8-pointed cam arrangement to move the damper bell crank as shown in accompanying sketch. This would give 8 complete cycles for each turn of the cam wheel compared with 1 as now, or 1 complete cycle with ⅛ turn of wheel—8 times faster.

The angular velocity is 0.639 degrees per second, so the angle moved through in 10 seconds is 6.39 degrees. The size of the crank wheel is not given, nor is the vertical movement of the damper operating rod. The length of 1 degree of arc depends on the circumference of the wheel. The two arms of the bell cranks could be proportioned to give the necessary movement.

The connecting rod would be discarded and the control unit moved up into position shown or else bell cranks extended to suit conditions. The dampers could be adjusted to give the minimum air required to maintain ignition at light or no load.

Pittsfield, Mass. ALBERT H. MOULTON

Answer No. 378

WHY DO DUPLEX PUMPS SLAM WHEN FEEDWATER TEMPERATURE DROPS?

Venting the Pump Will Help

THE PECULIAR behavior of J.R.H.'s pumps is common to all heater drain pumps, reheat boiler driven drain pumps and low head pumps that handle hot water.

When the compressor was in operation about 6 psig was maitained over the feedwater in the heater. Soon as the compressor stopped, a partial vacuum was formed over the water pulling it back up into the heater from the pump suction pipe. The pump parts (piston, cylinder, valves) having been previously heated to 230 F cause whatever water they are in contact with to boil violently. Soon as the pump parts cool off, the pump will work again. This may be hastened by venting the pump.

Chicago, Illinois WALTER HEIDECKER

Introduce Live Steam to Maintain Heater Pressure

FROM THE description given by J.R.H. I would say he has a right nice case of vapor binding. The fact that the pump will sometimes quiet down before it can be reached indicates a high percentage of makeup.

When the supply of exhaust steam is suddenly cut off and the pressure drops in the heater, the column of water in the suction line must be cooled down before the pump will handle it at the reduced pressure. There is just sufficient drop in pressure due to friction and pump intake to cause flashing in the cylinders.

It might be advisable to introduce live steam into the heater during the periods the compressor is unloaded. This can be done through a pressure regulating valve, set to operate at a predetermined pressure drop in the heater. This would eliminate the pump trouble and provide a more uniform feed temperature.

Junction City, Kansas.

CLOYD J. RAY

Feed Steam to Maintain Heater Pressure Constant or Slow Down Pump

THE PUMPS work normally when the feedwater is at 225 deg to 230 deg temperature because the pump packing and cylinder are expanded causing a good tight fit. But when the temperature of water drops to 205 deg then the water is cold in comparison. Therefore, there is a certain amount of vacuum formed in the pump, packing contracts, pump stroke speeds up and cylinders do not get a full cylinder of water. Then on the return stroke, the cylinder will not be full of water and the piston will slam.

The remedy is to install a small reducing valve to feed five (5) pounds of steam to heater to make up the loss of exhausted steam when the compressor is not in operation. It will pay for itself very shortly by increased efficiency from always having hot feedwater. Also by preventing the cylinder heads from being knocked out.

As you say, sometimes the pump will pull itself out of the trouble before you can get to the pump but at other times it will not do so. Slowing down the pump speed for just a few minutes, being careful not to get low water in boilers, will remedy the trouble also and save trouble of starting up the other pump.

Ontario, California JACK PITTS

Change Tension on Suction Valve Springs—Says Strickland

J. R. H. says his duplex pump acts as if it was vapor locked because it slams. Well, that is just what happens. The cause of this is the high resistance to the flow of liquid into the cylinders, and probably most of the resistance is through the suction valve itself.

The remedy, of course, is to make the suction valve open easier, and that means put on a much lighter tension spring on all suction valves. His trouble will disappear entirely when the correct spring tension is obtained.

I had the very same experience with a 10-6-12 duplex pot valve pump installed about one year ago which handled water at 220 F with a suction head of about 16 ft.

As far as the change of temperature is concerned in his case, do not worry about that, even if the change is as great as 100 degress.

Holyoke, Mass. L. W. STRICKLAND

Comments by Mitchell

It seems to me that J.R.H. has touched the source of the difficulty when he says that the pump "starts acting as though it had a vapor lock". The pressures existing in the open heater concurrently with the various water temperatures are not stated; however, it is safe to say that if the unit is of good design and properly operated, the water is being heated to within a few degrees at least of saturation temperature. Thus at the instant of pressure drop, the stored water is superheated and a portion is flashed off to restore the thermal equilibrium. When the pressure variation is large and sudden, as seems to occur in this case, it is readily possible for steam bubbles to form all the way down to the pump suction.

Sudden pressure changes are to be avoided in the operation of an open

feedwater heater and several methods are employed to this end, the best solution for a particular problem depending, of course, upon the means available and the plant requirements. There is no point in speculating on possible solutions without knowing more about the cycle in question, but I would certainly recommend to J.R.H. that he endeavor to stabilize the operating pressure in his heater.

DAVID M. MITCHELL

Bloomfield, N. J.

Use Insulated Pump Suction Tank

IN THIS PROBLEM, I am inclined to believe that the trouble is not due to a drop in feedwater temperature but in the heater pressure. JRH states that the feedwater temperature is normally 225 to 230 F, which corresponds to pressure of from 4.3 to 6.3 psig pressure. When the steam driven compressor slows down, the feedwater temperature drops 25 or 30 deg. This means that the temperature has dropped to 200 deg corresponding to 6 in. of vacuum. This sudden drop of pressure allows some of the feedwater to flash into steam or vapor. If the pump is running fairly slow, the water has a chance to flash into steam in the suction chamber of the pump, passing into the discharge head and vapor binding of the pump. Then as the water stopped boiling, the vapor condenses and the pump starts working again.

I believe the best way to get rid of the trouble is install a separate insulated tank for the pump to take its suction from. The tank can be vented to the atmosphere and the water from the heater can overflow into it. The water will be always at constant temperature and pressure.

Another remedy is to install a small cold water line into the suction chamber of the pump. Usually a ½-in. or ¾-in. line will do. When the pump becomes vapor bound, the operator merely opens the valve until the trouble is cleared and close it again. I was on one installation where a well-water line under pressure was connected to the pump suction header at the pump. When the pumps acted vapor bound, as JRH's does, we "cracked" this valve and the trouble cleared up in a few minutes and we closed it again.

The main objective to this method is that the operators are liable to become careless and leave the valve open, feeding cold water to the boilers and sending hot water to the sewer. However, with conscientious operators, this need not be the case.

Baltimroe, Md. CHAS. W. PARKS

Maintain Constant Heater Pressure; Look to Pump Valve Springs

IN AN OPEN feedwater heater, the exhaust steam and the feedwater are brought together and intimately mixed, so that the temperatures and pressures of each correspond, for all practical measurements. A feedwater temperature of 225 to 230 F indicates that 5 or 6 lb of back pressure is being maintained in the exhaust line and heater. When the load on the compressor decreases, there is less exhaust steam available and the back pressure drops. This is shown by the drop in temperature of the feedwater. If a good compound gage is connected to the heater or exhaust line, observations made during the change in load will prove this.

It is stated that the temperature of the feedwater drops 20 to 25 deg when the trouble occurs. This indicates that a pressure below atmospheric exists at such times. Even though the static head over the pumps is 14 ft, corresponding to a pressure of 6.02 psi, the reduction in back pressure is enough to cause a portion of the feedwater in the suction pipe to flash into steam. On the suction stroke the pump cylinder fills with steam instead of water, and on the pressure stroke the plunger meets with no resistance, as the steam is easily compressed in the large clearance space. The moving parts are driven forward by the full steam pressure behind the piston and bring up with a slam against the head.

The most effective way to remedy the pressure which causes the slamming is to introduce a reducing valve between the high pressure steam line and the exhaust main. A good pilot-operated single-seat valve should be used, as a dead-end shutoff and full response for a small decrease in pressure are important. Spring or weight-loaded double-seat valves are not satisfactory for this service.

The pressure at which the reducing valve shuold be set to open should be less than the opening pressure of the atmospheric valve to avoid waste of steam. The size needed will be determined by the heating, hot water or other load on the exhaust line. If all the steam from the compressor exhaust is used, a calculation of the number of pounds of live steam needed to supply the same amount of heat may be made to determine the size of the reducing valve.

The maintenance of a steady back pressure will eliminate the slamming of the pump when the compressor load is reduced. If this trouble occurs at other times, however, an investigation of the pump section line is in order. Scale or other substances may be restricting the area of the pipe and causing vapor lock because of the higher suction necessary to pull the water into the pump cylinder.

Excessive spring tension on the suction valves can also be a cause of pump slamming. When the temperature of the water is high and the head over the pump is low, the springs should be removed entirerly, as the pump will work more efficiencly and smoothly without them.

Seabrook, N.J. JOHN L. ANDERSON

Answer No. 382

HOW SHOULD HE LINE HOT-WATER STORAGE TANK?

Mullen Tells What He Did

WHERE I WORKED in a laundry some years ago, because of an increase in business the hot-water supply was not sufficient and it meant getting another tank. As the first hot-water tank was in the building there wasn't enough room to put the new tank in the building. Before I go further the tank was bought second hand and it was of 3000 gal. capacity.

It was installed on the roof after having been checked by the building inspectors; there weren't any coils in this tank at all. The cleaning was done with scrapers and a motor driven wire-brush. We of the engineers crew were to do it, but due to a major breakdown this job was done by an outside concern and a cement lining was used and a good job because it lasted three years before any sign of a crack showed. This was a piece about 6 in. in diameter. The chief and myself cut a piece about 18 inches square to make sure there wasn't any corrosion. We then patched this spot and the following year the tank was still in fine shape. I changed my position soon after that and don't know how long this held up.

This tank was hooked up with the first or main tank and was about 3 ft. above it and about 15 ft. from it. It was insulated and had a relief valve installed on it. The heating coil was in the main tank and it circulated the water through these tanks but his cement finish was more like a hard white porcelain when it was finished. It was a good job and we had good luck with it.

WILLIAM T. MULLEN

Philadelphia 43, Pa.

Parks Says Paint Will Do Job Inexpensively

F. A. W. asks about coating a hot water storage tank. I have had very good results with a green paint manufactured by the Continental Fibre Products Co. It is a green paint and very strong. It has to be put on with a gas mask and used to sell for $5.00 a gallon. It is usually brushed on heavy and given two coats. There should be a drying period of about 24 hours before closing the tank up. The paint will not harm food or clothes and lasts about a year.

Baltimore, Md. CHAS. W. PARKS

Answer No. 374

WHAT ARE DUTIES OF WATCH ENGINEER, FIREMAN, OILER?

Power Plant No Place for Lazy or Unintelligent

THE POWER PLANT in any industry is classed as a service department. The operating personnel's primary objective is to provide service so that production can go on without any stoppage. In the performance of every-day routine work, the engineer on watch is entrusted not only with furnishing satisfactory service to production, but also is entrusted with equipment valued at hundreds of thousands of dollars. He must not

only start and stop the primary power-producing units, but he must also spend time in watching over their performance. He is in charge of his watch. The fireman, oiler, and coal passer are his subordinates and he should supervise them for the good of the organization.

In our plant, the power plant organization is made of a crew of men with a chief engineer in charge. The watch engineer starts and stops the prime mover. The oiler is really the engineer's helper.

The engineer on watch makes inspections of the running equipment every 20 min. He analyzes the boiler water and prepares the treatment of the water, keeps a log sheet or record sheet of the performanec of his equipment, reports all necessary repairs to be made and also reports any unusual conditions that may exist. He makes inspections of the boiler room and sees that everything there is running properly.

The oiler's work is such that not only must the equipment be lubricated but kept clean. He must report any unusual condition to the watch engineer.

The fireman is responsible for a smooth-running boiler. He must keep a suitable fire in the boiler furnace so that he has an adequate steam supply to the prime movers. He should keep the boiler room clean, see that his equipment is operating satisfactorily and, if anything is not in order, he should immediately notify his watch engineer to that effect.

Operating a power plant is a very serious business, because everything hinges on the engineer. The men in power have to be sober, intelligent, industrious and work for the good of the organization. We cannot put off till tomorrow things that must be done today. The men have to use good judgment; mistakes in judgment can cost a serious shutdown, involving thousands of dollars loss of production and throwing hundreds of employees out of work until the power house can go back on the line.

All in all, power plant engineering is no place for the lazy or unintelligent worker. The engineer and his crew must be on the alert for most any emergency and be able to think and act right at the right time and should leave nothing to chance.

JOHN F. SLAVINSKY
Rochelle Park, N. J.

Answer No. 391

HE WANTS STEEL-WORK DESIGN FOR TRACK SUPPORTS OVER COAL BUNKER

IN THE August issue, WNS showed a diagram of his present underground coal bunker adjacent to his boiler room, said he wanted to enlarge it and asked how to figure the steel for supporting the railroad track over the bunker.

Present bunker is 45 ft long by 30 ft wide by 17 ft 6 in. high to be extended 20 ft below grade to a total width of 50 ft. The present outside reinforced concrete wall and the new side wall would support steel roof beams and over the present wall, on the ends of the roof beams, the railroad track would be supported.

It is desired to store 16 carloads of stoker coal. Cars would be dumped direct into the bunker.

Hudson Says—Use roof of present bin to distribute coal to ground storage. Use bulldozer to return it to bin.

It is risky to try solving a problem without knowing all the conditions, but here is an attempt at the solution which seems best to me.

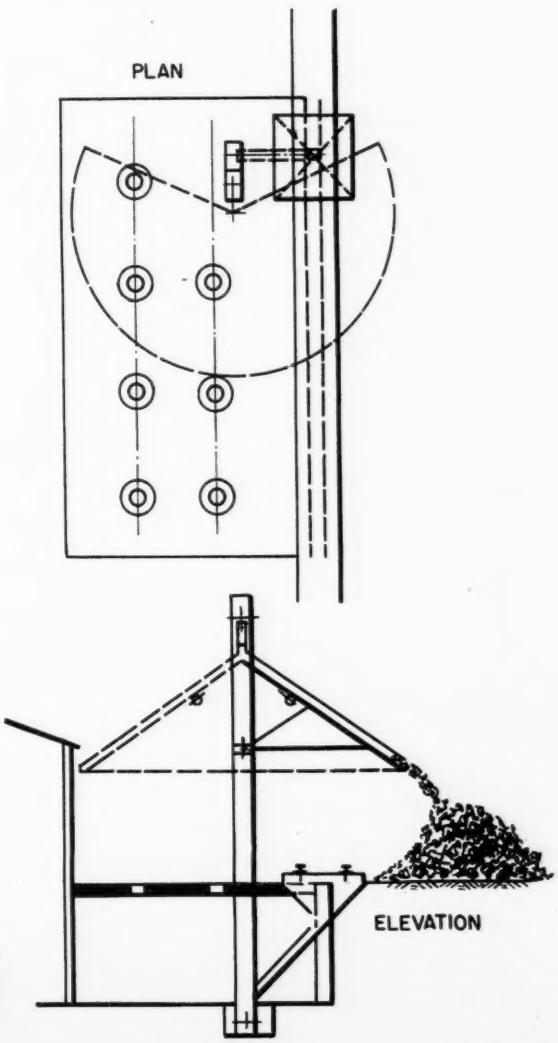
It would seem unlikely that the railroad engineers will approve the track supports as sketched. The proposed reserve storage of 800 tons is unusually large for a steam plant of the size his appears to be. Storing the coal in a wide bin, as proposed, means a high labor cost both for storing out and reclaiming. As the angle of repose for bituminous coal is about 35 deg, the bins can be only partially filled except with much hand trimming.

My suggestions would be as shown in the sketch. Eliminate the new bin. Locate a bucket elevator near one end of the present bin, with track hopper and pivoted chute. This chute distributes the coal across the roof slab of the present bin (reinforced if necessary) or to a pile on the ground.

Distribution of ground storage can be by a small bulldozer, which also would reclaim, either to the track openings or to the elevator. Perhaps the bulldozer can be used to push bin-stored coal over to the elevator, which piles it closer to the boiler house wall openings.

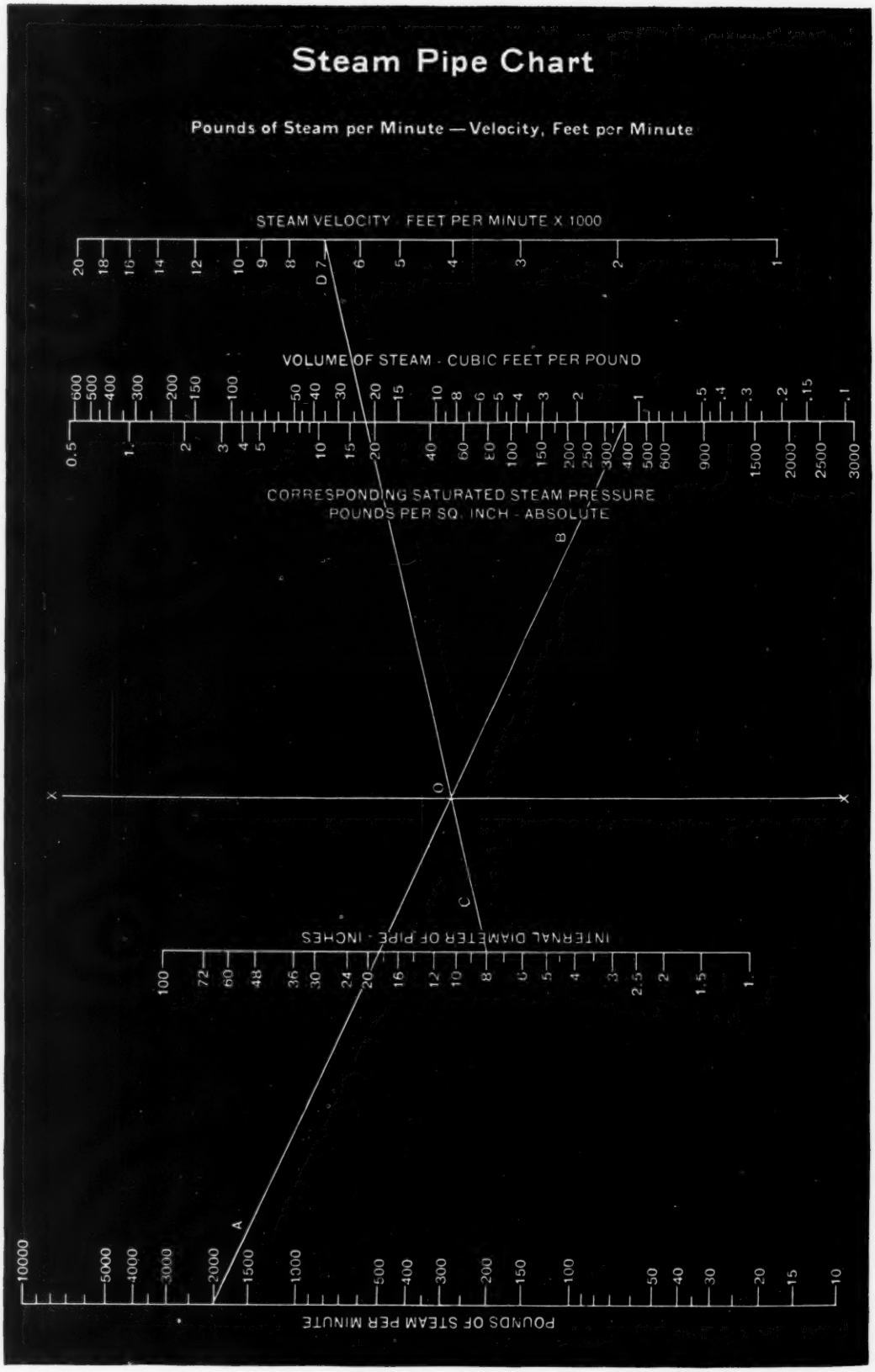
The question does not state whether the plant is stoker-equipped. If that is so, of course the addition of stoker hopper filling conveyors may be readily arranged.

Chicago, Illinois W. G. HUDSON



Suggested construction by W. G. Hudson for solving W. N. S.'s coal bunker problem

For explanation see page 89



Reprinted Courtesy National Valve and Mfg. Co.

Weighing Coal in the Power Plant

Details of construction, comments on installation and operation, covering principal coal weighing devices used in power plants . . . The weigh larry . . . The coal meter . . . Batch and continuous weighers . . . When handling wet coal, weighers must be checked periodically to allow for water content

By **WILBUR G. HUDSON**, *Consulting Engineer*

SIMPLEST non-automatic device for weighing and distributing coal is the weigh larry, Fig. 1, in which a hopper is suspended in a platform scales with the weigh-box brought down to a convenient height above the floor. If the machine is mounted on anti-friction bearings, a larry with a hopper capacity up to 1500 lb is readily pushed along its runway. For larger capacities, the larry should be motor operated, at a cost of about $500 additional for a larry of medium capacity.

If the coal is dry, an objectionable dust is scattered as the coal flows from the bunker gate. If desired, the gates may be interlocked with the larry so that a gate may be opened only when the hopper is in position, and the larry can be moved only after the gate has been closed.

The chief advantage of the larry is that coal from any section of the bunker can be transferred to any stoker hopper. The travel speed should be less than 75 ft per min to minimize shock on the hardened steel knife edges of the scale mechanism. Even then, sway stops are desirable.

Simplest device for recording the weight of coal chuted to a boiler is the ingenious Bailey meter. It is a measurer rather than a weigher. A section of helix is mounted on the center line of a chute as in Fig. 2 and geared to a revolution counter. After calibrating, the rotation of the helix will measure the weight of coal flowing through the chute to within an accuracy of about 1.5 per cent. If the chute should empty, as when the coal hangs up above the meter, the helix will spin as the coal falls, so the readings are valid only for a continuing flow. Moreover the chute must be within 20 deg of the vertical position and the coal must be granular or without large lumps.

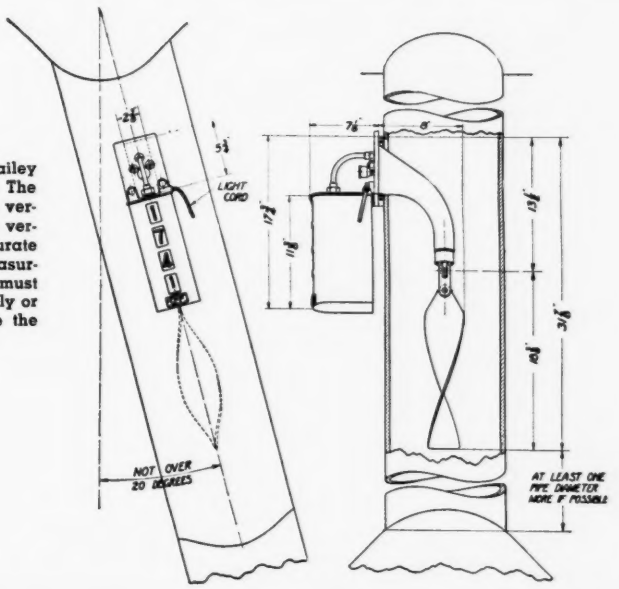
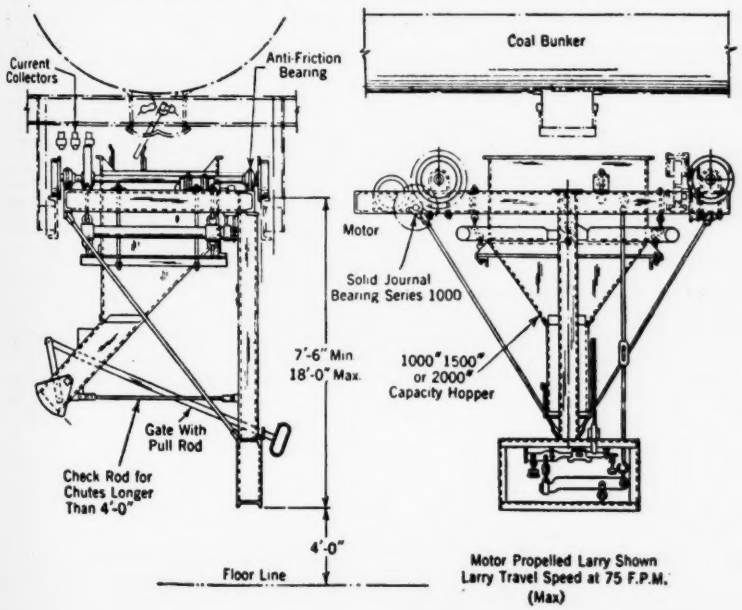


Fig. 2. The Bailey Coal Meter. The chute must be vertical or nearly vertical for accurate weighing (measuring). The coal must flow continuously or not arch above the helix



Motor Propelled Larry Shown Larry Travel Speed at 75 F.P.M. (Max)

Fig. 1. A typical weigh larry. (From *Conveyors and Related Equipment;* Hudson. John Wiley & Sons)

Batch Type Weighers

The various automatic weighers are either batch or continuous weighers. The Richardson and the somewhat similar Stock weighers are batch type. The Richardson scale is shown in Fig. 3. Essentially it consists of a counter-weighted weighing hopper fed by short belt feeder. When the weight of coal in the hopper balances the adjusted weight, the hopper drops slightly, stopping the feed and opening the hopper discharge gate. When the hopper is empty, the gate closes and the cycle repeats. Each drop is recorded on a counter. The standard sizes range from hopper capacities of

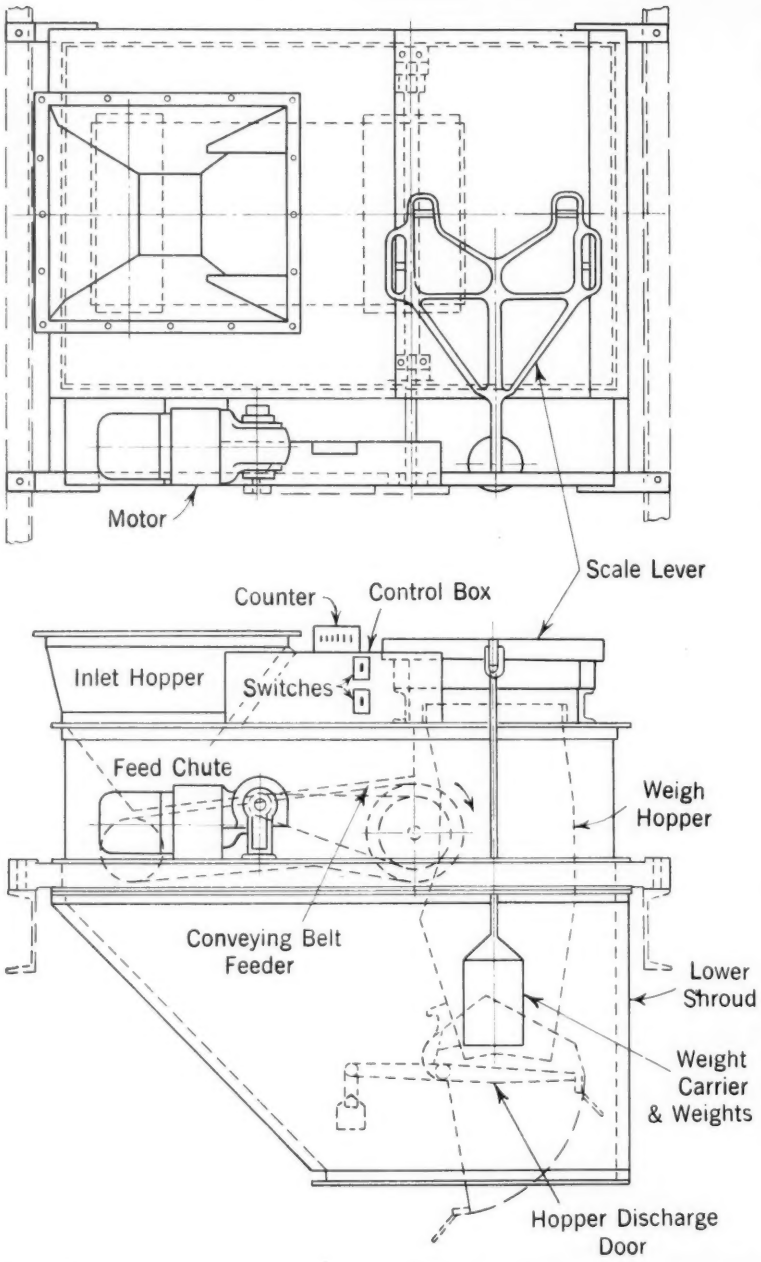


Fig. 3. The Richardson automatic scales. The belt feeder may have considerable length, as when extending beneath two or more bunker gates

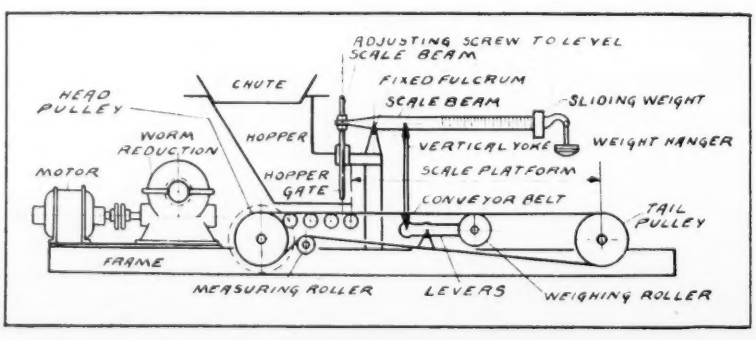


Fig. 4. The Schaffer Poidometer. This device depends on the movement of a constant volume of ribbon of material

200 to 1000 lb and the machine is stated to have an accuracy of within 0.5 per cent, under average conditions. If the coal outflow should be blocked by coal already discharged, the cycle stops until the receiving hopper has cleared; thus the scale functions only at the rate called for by the consumption.

The Schaffer Poidometer and the Hardinge Feeder-Weigher are simple automatic continuous weighers adapted primarily to chemicals rather than coal handling.

The Poidometer

The Poidometer, Fig. 4, depends on the movement of a constant volume ribbon of material. A short pivoted belt, supported at the exact center of its length, by a scale beam, which as it lifts or falls, lowers or raises a gate controlling the flow from the feed hopper, thus leveling the stream on the belt to a depth or weight per foot of belt determined by the setting of the scales, and with only such variation of the load as results from irregularities or lack of homogeneity. An agitator operated by a crank shaft prevents clogging or arching in the hopper, but if the material should hang up, the belt automatically stops, and re-starts automatically when the flow resumes. A meter records the number of feet travelled by the loaded belt and this, multiplied by the weight at which the scale beam has been set, registers the pounds delivered.

The Feeder-Weigher

The Feeder-Weigher, Fig. 5, holds the weight constant. A short pivoted belt takes the material from a hopper at a rate controlled by a weighted lever, which opens or closes the hopper gate depending on the load on the belt. The rate of feed is adjustable either by adjusting the counterweight or by a variable-speed drive. The belt maintains a constant rate of discharge by weight and a revolution counter records the distance the belt travels.

The Weightometer

Another device widely used for automatic weighing in coal handling installations is the Merrick Weightometer, Fig. 6. Usually this continuous weigher is employed in connection with a belt conveyor. The scheme of operation is simple and ingenious. As shown in Fig. 6, an integrating disk A3 has crowned rollers around the periphery and is free to tilt under the pull of the weighbeam transmitted by G3. The narrow belt J5 encircles the disk and is driven from the return run of the conveyor belt, from W to pulley A5.

The mechanism is adjusted so that when there is no load on the conveyor, the disk is at 90 deg with the

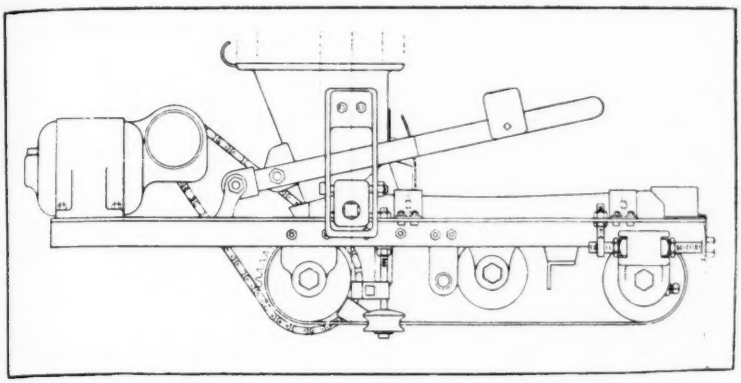


Fig. 5. The Hardinge Feeder-Weigher. The short pivoted belt takes the material from a hopper at a rate controlled by a weighted lever

travel of the belt J5 and does not rotate. Any load on the conveyor belt tilts the disk and it rotates slowly, depending on the degree of tilt, which in turn depends on the load on the conveyor. The rotation is a measure of the weight of material passing over the suspended section of the conveyor belt, and, after calibration, the counter registers the total weight conveyed.

It is necessary to have a length of about 30 ft of straight run from end to end of the conveyor for accurate weighing, though a modified design pivots a section of belt about 12 ft long. The short conveyor may have a magnetic head pulley, thus combining the weighing and separation of tramp iron in one assembly.

Properly checked, the weightometer has an accuracy to within 0.5 per cent under average conditions. To check the adjustment, a length of roller chain of known weight per foot is anchored to rest on the conveyor. When the conveyor is in motion the effect is exactly the same as if the conveyor was handling a stream of material of corresponding weight per foot. A check about once each month is desirable for an active installation.

Problems in Coal Weighing

With any type of automatic or non-automatic weighers, the record can be falsified intentionally. If the coal is wet, the weight record is that of the coal plus that of the water and must be discounted through an occasional check of the water content. It seldom will be more than 10 per cent.

Small coal, such as anthracite, No. 3 Buck and rice, and ⅜-in. or smaller bituminous, is troublesome all along the line when damp. It is difficult to get such coal out of a hopper-bottom car, to clean it from a conveyor belt, to prevent it from building up in elevator buckets, to feed it from a bunker and through bunker chutes. Much of the small bituminous is dry-cleaned at the preparation plants but if rained upon in transit, especially in cold weather, it is sticky.

Several devices are effectual in easing the discharge from cars, as described in detail in the June 1947 issue, pages 118 and 120. One is a two or three ton slicer carried on a gantry spanning the track, which slices off the face of the load and pushes it down through the gates. Another is a car shakeout; still another has augers that screw into the coal. If the coal is frozen in the car it is still more troublesome. One device is an open-top firebrick box containing opposed atomizing oil jets, and located between ties adjacent to the track hopper, so that the heat is reflected upward against the car bottom. It is claimed that a solidly frozen load can be thawed in a half hour without damaging the car, but this seems optimistic.

Weighing is awkward with sticky coal since it persists in adhering to the feeder belt, the hopper, hopper chute and gates. Frequent inspections are necessary so that the residue will not be repeatedly recorded as coal weight.

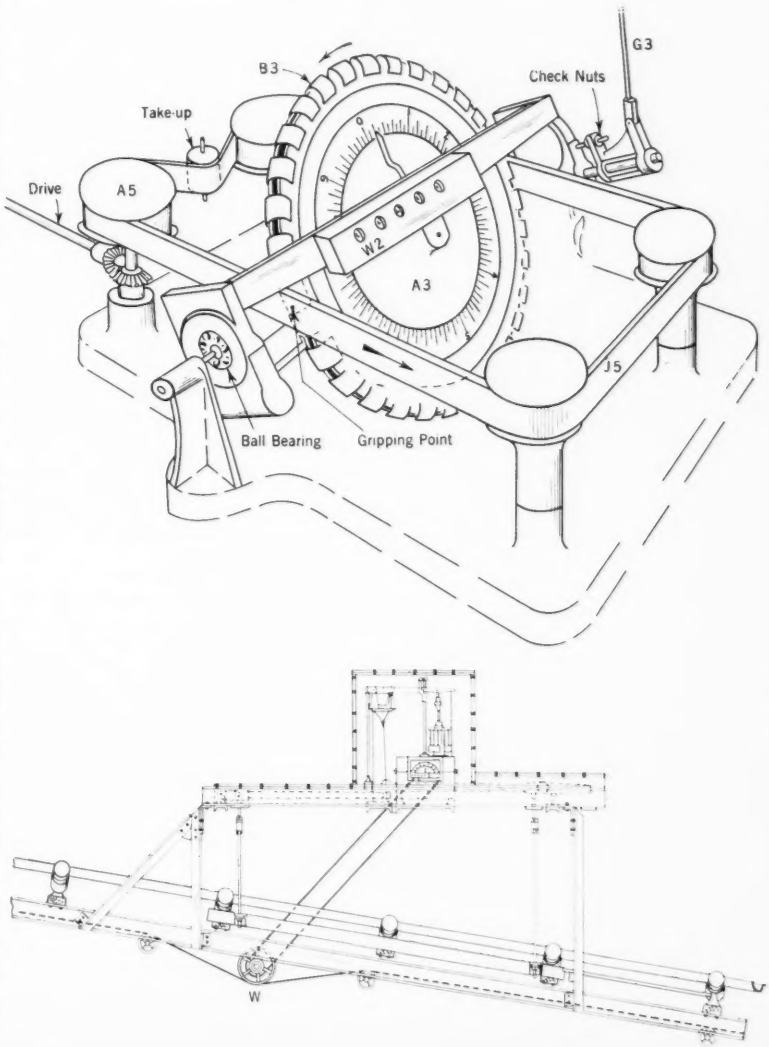


Fig. 6. The Merrick Weightometer. The weightometer records the weight of sized or unsized coal with lumps up to the capacity of the conveying belt. Above—Detail of weighing or measuring mechanism. Below—How measuring mechanism is operated from coal conveyor

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

Problems in Atomic Power Development

Plants for immediate and future nuclear research . . . New nuclear energy laboratories . . . First problems in atomic power plant design . . . Power production as related to the production of radioactive isotopes . . . Requirements for protection of personnel in nuclear energy plants . . . Phyiscal arrangement of plants . . . Control Economics of radioactive isotope production . . . Effect of widespread use of long life tracers

By ANDREW W. KRAMER, *Managing Editor, Power Plant Engineering*

IT IS A LITTLE over two years now, since the first atomic bomb was exploded at Alamagordo, New Mexico. Since that time four others were exploded, two over Hiroshima and Nagasaki in Japan and two in the tests at Bikini in July, 1946. Startling as these blasts were, much of the initial excitement over them has died down. Since Bikini, atomic energy has not been of particular concern to the general public. Much has been said and written about it by popular and scientific writers and lecturers and the newspapers report the continued lack of action on international control but no startlingly new developments have taken place to make the world more conscious of nuclear energy.

Yet in scientific circles much work is being done and much more is planned for the future. Besides the original laboratories and plants in which the work of developing the atomic bomb was carried out a number of new ones are being built. Of direct interest to power engineers is the new General Electric Knoll's Laboratory being built near Schenectady since that unit will concentrate on the problem of generating usable power from atomic piles. Preliminary work on the generation of power is now in progress at Oak Ridge, Tennessee (the Daniels pile). The Argonne Laboratory, near Chicago, will concentrate on the fundamental design of atomic piles without stressing the practical details of power production. Another laboratory, the Brookhaven National Laboratory at Patchogue, Long Island, N. Y., to be operated by nine Eastern Universities, is still in its earliest stage of development but it will o fcus on basic nuclear research—on the mesotron, positrons and negatrons and on such things as "binding force." Everywhere new and more powerful accelerating equipment—cyclotrons, synchrotrons, betatrons, etc.—are being developed to meet the need for continually higher bombarding energies.

These developments are concerned mostly with fundamental research. As far as the production of power is concerned, the general pattern for an atomic energy plant is well set. It will consist of a "pile" or reactor "burning" U-235, generating heat and at the same time, producing plutonium which also is fissionable. The heat will be used to generate steam or produce high temprature gas for the operation either steam or gas turbines.

The principles are quite clear but many difficult problems have to be solved before a practical power system can be developed. The immediately important job is to build a pile that can run "hot," that is, at temperatures around 900 deg F, the temperature level of modern high pressure boilers. This is a long way from the mildly warm reactors at Hanford and the first piles at the University of Chicago. The Chicago piles ran cool because of their low output —the Hanford piles because the object, there, was to produce plutonium.

Thus, the first object of the Daniels pile at Oak Ridge is not the production of heat for power, but the establishment of methods and principles for operating the pile at high temperatures.

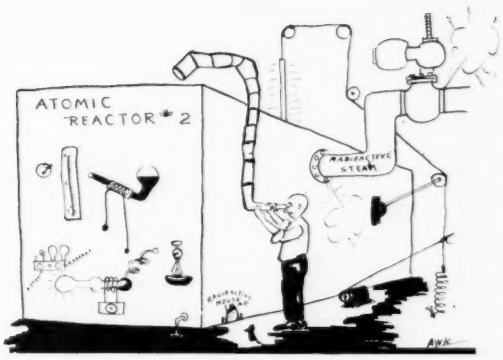
The scheme for an atomic power plant is shown in Fig. 1. In this particular scheme, the by-product production of radioactive isotopes is included, although this feature would be optional. It is shown as the adding to the pile of a by-product charge of some "parent" material such as nitrogen from which radioactive carbon (C-14) is produced by the capture of neutrons.

ATOMICS

The neutrons in any pile are valuable and for efficient operation every means must be used to conserve them. By controlling the neutron flux, the power output of the pile is regulated. To hold the power level constant rods of neutron absorbing material such as cadmium are inserted into the pile to absorb some of the neutrons so that equal numbers of neutrons are available to produce fissions at each generation.[1]

To increase power, the rods are withdrawn so that a small portion of the excess neutrons is available at each generation to produce fission. The power then accelerates exponentially. It will continue to accelerate, except for variations in reactivity produced by temperature, expansion of materials, or change of their neuclear properties, until the control of rods are again pushed in to absorb the excess neutrons. After the control rods are returned to an equilibrium position the reaction continues at a constant but **higher** rate. To reduce the power, the process is reversed.

This method of operation would not be possible, if all the neutrons emitted at fission were emitted instantly. The time between one generation of the neutrons emitted instantaneously at fission and the next generation is extremely short. This is true even in slow neutron piles where each neutron is forced to lose almost all of its energy by a multitude of collisions with the light nuclei of the moderator before the next fission. (See Fig. 2.) The time is so short that acceleration, even with small changes in reactivity would be too fast for the control mechanism to be effective were it not that about one per cent of the neutrons is not emitted promptly at fission, but is delayed from 0.01 second to a minute or more.[2] This time delay gives a sort of inertia to the chain reaction that greatly facilitates its control.



Any visual observation of mechanisms will have to be accomplished through the use of optical devices

As already mentioned, the first real problem to be solved in the development of a practical atomic power plant, is to design a pile that can operate at temperatures of around 900 to 1000 degrees. This naturally involves the selection and development of materials — moderator material, enclosing envelops or cans for the U-235, heat transfer fluids—the solution of complicated stress problem and, of course, many control and automatic conveying problems.

These, however, constitute only one phase of the work that must be done before we can expect practical neuclear power plants. Even more important, are the problems that have to do with the protection of the lives and health of the personnel needed to operate the plant, and the handling of highly radioactive materials. Fortunately, here, the experience gained at Hanford as well as that of the relatively old radium industry will be helpful. The thorough experimental studies started by the Manhattan District and continued by the Atomic Energy Commission and its various contractors have led to definite conclusions regarding (1) the safe limit of exposure to external radiation, (2) the amounts of various radioactive materials which can be safely tolerated in air, on the skin or within the body.

Generally speaking, the maximum dose of external radiation considered safe over an indefinite period of time in 0.01 R per day (1R = 1 Roentgen; that is, the radiation, which under standardized conditions, will cause 1000 ionizations per cubic centimeter).

The problem of designing a nuclear power plant as far as the workers are concerned resolves itself into the same factor as that which prevails in any "hot" laboratory: **without unduly affecting the ease and efficiency of manipulations, each worker must receive less than 0.01 R of radiation per day.**

To keep the radioactive exposure below this safe limit, the most obvious steps are:

1. Control the amount of radioactive material that may accumulate in any one place.
2. Use of shields.
3. Control of the time of exposure.
4. Use of distance.

It might be assumed that in any practical plant all four of these safety factors would be applied at once but this is not always possible. It might often be necessary for operators to work in regions of intense activity. In such instances the other precautions must be accentuated, shielding must be thicker and more extensive, the time of individual exposure must be reduced (by relays of workers, each working only a specific time), and by placing the operators at a greater distance from the source of radiation.

Since the reactors used in nuclear power plants would be very large ones, (like the ones used at Hanford for the production of plutonium) they probably will be installed in concrete buildings with very thick walls. The reactor rooms might be

[1] By a "generation" is meant one complete step in the chain reaction. When one neutron effects fission of a U-235 nucleus, producing, say two additional neutrons, the process is said to be one generation.

[2] The question of "delayed neutron" was very important in the early work of the Manhattan District. Some of the early experiments in this directon, indicated that 1.0 per cent of the neutrons emitted in uranium fission are delayed by at least 0.01 second and that about 0.7 per cent are delayed by as much as a minute.

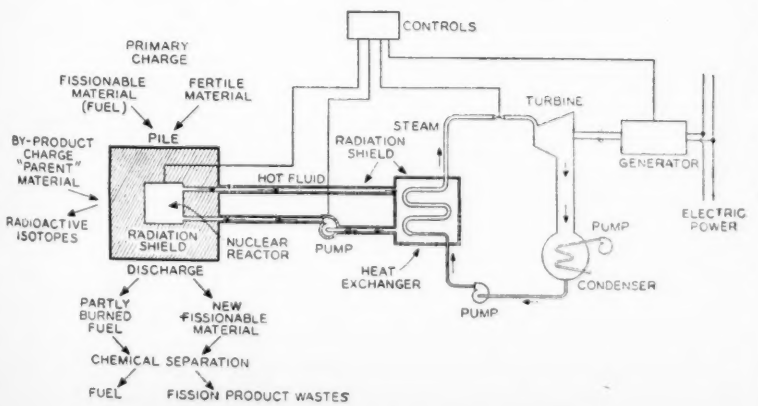


Fig. 1. Schematic diagram of an atomic power plant

ATOMICS

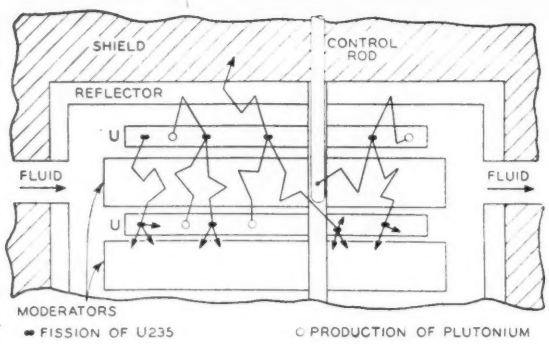


Fig. 2. Schematic structure of a uranium pile

placed entirely underground. Once placed in operation, the doors would be sealed and would remain sealed against entrance of human beings as long as the pile was in operation and for a long time after it was shut down. Any visual observation of mechanisms (automatic conveyors for loading the reactor and removing the plutonium) will have to be accomplished by the use of optical devices, or perhaps by television equipment. It may be recalled that television equipment was used at Bikini for viewing the bomb explosions at close range.

The fuel (U-235, plutonium, thorium) will have to be delivered to the reactor by a conveying system, so designed that it can be loaded and unloaded by remote control. After the fuel has been "burned" in the reactor, the residual material must be removed from the pile to a chemical processing plant where the plutonium can be separated from the very active fission products and the uranium. All this will have to be done by complete remote control, since all the conveyors, chemical separating equipment, etc., will be highly radioactive and will be installed behind heavy concrete walls.

The reliability of the reactor control system must be absolute—it must be designed so that any failure must result in safety rather than permit a runaway. It must be able to handle all possible variations in reactivity of the pile, either normal or accidental, gradual or fast, such as might result from the slow consumption of the fuel or the sudden loss of part or all of the heat transfer fluid. It must be effective at all times, under any possible set of conditions. It must make it impossible for the nuclear boiler ever to explode. These requirements are rigid and must be met.

While this involves a tremendous amount of engineering, there seems little question that it can be done because similar arrangements are in successful use in the present chain reacting piles at Hanford, Washington.

Another problem of great importance is the selection of a fluid to carry the heat from the nuclear reactor to the heat exchanger or boiler. Gases, liquids and liquid metals must all be considered. Whatever medium is used, it must have low neutron absorption. It must be reasonably stable under intense radiation and it must possess good heat transfer characteristics, be non-corrosive, preferably non-toxic and non-explosive. If it should be a liquid metal, suitable circulating pumps will have to be developed. If the medium is to be allowed to boil in the reactor then the neutron absorption characteristics of the vapor must be approximately the same as those of the liquid; otherwise a sudden flashing to vapor of a part of the liquid might result in such a sudden change of nuclear characteristics in the pile that the control mechanism could not compensate for it.

If, in addition to power, the plant produces radioactive isotopes a host of other problems arise which need solution. The handling of radioactive materials requires special equipment and special techniques, particularly in the associated laboratories where such radioactive isotopes are tested. Already, much work has been done in this direction in connection with the use of radioactive tracers in laboratory work. All surfaces in such laboratories should be hard, smooth and streamlined in order to be easily cleaned to prevent contamination. Less than 10^{-12} gram of hot material may be a severe cause of contamination. Stainless steel has proved satisfactory for working areas, and hard tile is probably suitable for walls and floor. Some of the new industrial plastic tapes may be very useful as wall and surface coverings. If contaminated they could easily be replaced.

For the average laboratory worker's protection, i.e., workers handling radioactive isotopes, open top shields may prove most practical.[3] For convenience in handling the materials and in mounting remote control devices, the shield should not be thicker than one foot. Such an amount of concrete affords good protection. The open top shields should be about 6½ ft high, if the working surface is 3 ft or less from the floor. A system of mirrors over the area permits some visual observation and periscopes and remote control devices running on tracks on the top of the shield permit a wide latitude in operations. Some workers prefer the shielded area in the center of the laboratory so that operations may be controlled and observed from all sides.

"Hot" materials, naturally, must always be handled by remote control. Three kinds of devices have been proposed: mechanical, magnetic, and hydraulic. Much development work remains to be done in the field. Whether or not the productions of radioactive isotopes will become an intimate part of nuclear power generation, depends upon a number of broad factors which only further experience can disclose. In most discussions of this subject it is taken for granted that there will be a great demand for radioactive materials for use either as tracers or otherwise. Tracers have already been found valuable but the extent to which they will be used in the future will depend upon their costs. The Carnegie Endowment Committee on Atomic Energy[4] estimates that for

[3] The Laboratory Handling of Radioactive Materials by Claude R. Schwab's Address at First Annual Conference of the Instrument Society of America, Pittsburgh, Pa., September 19, 1946.

[4] Atomic Energy, Its Future in Power Production. Carnegie Endowment Committee on Atomic Energy, Chemical Engineering, October, 1946.

How About some nice fresh C-14? Only $400,000 a gram.
How much is your Radioactive Carbon today?
RADIUM $100 lb today only
Flies for Uranium Fission
AWK

The extent to which tracers will be used in the future will depend upon the economics of the situation

ATOMICS

radioactive carbon (C14) to be attractive to industry it should be produced at about $500 per gram to reach mass use in petroleum, coal tar and similar large volume production. This assumes that a milligram (50 cents) could tag a ton of material at an additional cost of 50 cents for incorporating the tracer in the process, making a total cost of $1 per ton. The 1946 price of C14 from the Manhatten District was about $400,000 per gram.[5] The Carnegie Committee estimated that the market might pay about $10,000 per gram for C14 used in bulk organic chemicals and $100,000 per gram for use in pharmaceuticals. As pointed out by Winne,[6] however, actual use may develop unexpected advantages, and, of course, cost is bound to decrease as production increases.

The question of radioactive isotope production is stressed because it is almost a foregone conclusion that such isotopes will be by-products of atomic power plants. Indeed, the radioactive by-products of atomic power production, whether intentional or unintentional constitute a complicated problem, involving not only questions of technique and cost but also social health and welfare. A critical problem in production as distinct from the industrial or laboratory usefulness of tracers is the question of widespread distribution of all types of products and materials containing traces of radioactivity and the effect on sensitive materials such as photographic film, and on living things as a result of continual intimate exposure or possible ingestion by unwarned people or animals.

Some people believe that this problem will limit production uses to those isotopes with short half lives of perhaps a few days. Then a period of storage of products before shipment could eliminate virtually all radioactivity. Such consideration may limit the list of possible tracers. Carbon 14 for example has a half life estimated at 6000 or more years. Two other carbon isotopes, C10 and C11, have impractically short half lives of 8 seconds and 20 minutes respectively. Thus, as Winnie[6] points out, no carbon radioactive isotope is known which would be used if radioactivity of the product is objectionable.

These are important questions and while they do not concern the actual process of power production they are sufficiently related to power production to warrant close study by those who are to develop the plants. Few of those questions can be settled at the present time; they will have to await further experience and knowledge.

It is possible that experience will show that the amount of radioactivity required for tracer purposes in many products is so small that long half-life tracers can be used widely in metallic, organic and other materials. Then, industry may be faced with radioactivity in materials purchased for further processing, in scrap for remelting and so forth. Such background radioactivity, if uncontrolled, might interfere with the further use of tracers.

In short, the problems connected with atomic power development are numerous and varied and their solution will require many decades of experience and study. For the present, however, only the immediate problem concerning actual design of plants will be given detailed study. Atomic power plants for land use are certainly feasible, technically and probably will be attractive first where fuel is scarce and cost is high.

ATOMICS

[5]Atomic Energy in Industry. H. A. Winne, Electrical Engineers, July, 1947.
[6]Ibid.

CORRECTION NOTE—HOW TO SELECT UNITS FOR A STEAM-ELECTRIC STATION

In some copies of the July 1947 issue, Fig. 1 of the above article, page 104, had the red color blocks and cross-hatching incorrectly made up. The lower edge of the solid red triangles should have coincided with the horizontal line of 12 megawatt capacity in each case. The corrected diagram is shown below in black and white. Please substitute this for the original or read the original without regard to the red shading. The black and white diagram is correct.

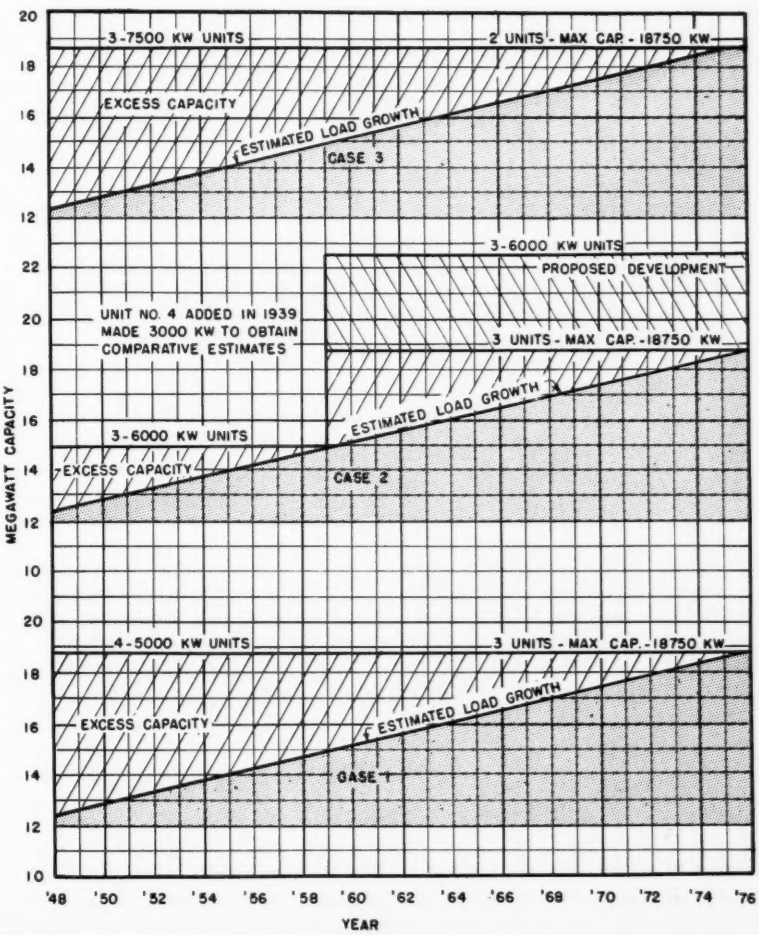


Fig. 1. Showing correct position of shading on original. This diagram gives a comparison of various proposals and selected units with anticipated load for a specific case

How to Buy Coal

Scarcity of coal suggests need for review of buying methods. Regular monthly deliveries, part going to storage, presents advantages. Coal chosen must conform to needs of plant handling and burning equipment. Information needed for intelligent selection of suitable coal

COAL this year is decidedly in a sellers' market under which condition those who must have this type of fuel are almost compelled to take what the dealers offer and pay the price they ask or go without. Coal is scarce and the consumer has practically no chance to shop around for a supply that can be purchased at a price lower than that asked by regular dealers, which, however, is seldom good practice since the quality of the coal is likely to be inferior and unsuited to the furnace for which it is intended.

Due principally to the coal miners' strike last fall and their vacation this summer coal in storage is down to an uncomfortably low point and retail prices are almost sure to rise 75 cents to $1.50 a ton as a result of increased pay to mine laborers.

There is little that the industrial consumer can do to hedge against these conditions except to insure himself against an exhausted supply by storing enough fuel to carry him over any conceivable emergency and see to it that his coal is being burned at top efficiency. It is, of course, possible that the increased pay to miners will be an inducement for them to produce more coal, thus assuring sufficient coal for the needs of the country and preventing a price rise proportionate to the miners' increase in pay rates, but this result is highly speculative and cannot be relied upon by coal users.

As a matter of policy, industrial coal consumers would do well to purchase their coal on an annual contract for yearly requirements with a provision that the coal be delivered in equal monthly allotments. With the adoption of this policy, the consumer, in nearly all cases, would need to provide necessary storage facilities to meet the terms of such a contract and assure an adequate supply to meet the possibilities of increased needs and failure of deliveries.

The adoption of such a policy by industries and communities generally would be helpful to the mine operators in maintaining a regular production schedule. Coal carriers could then plan for definite schedules in the hauling of coal. Stocks of coal would automatically accumulate during the seasons of low loads, which is usually between April and September. Such conditions of coal delivery should be conducive to price reduction since they would remove peaks and valleys in the curves of production and transportation which increase costs and cause price fluctuations.

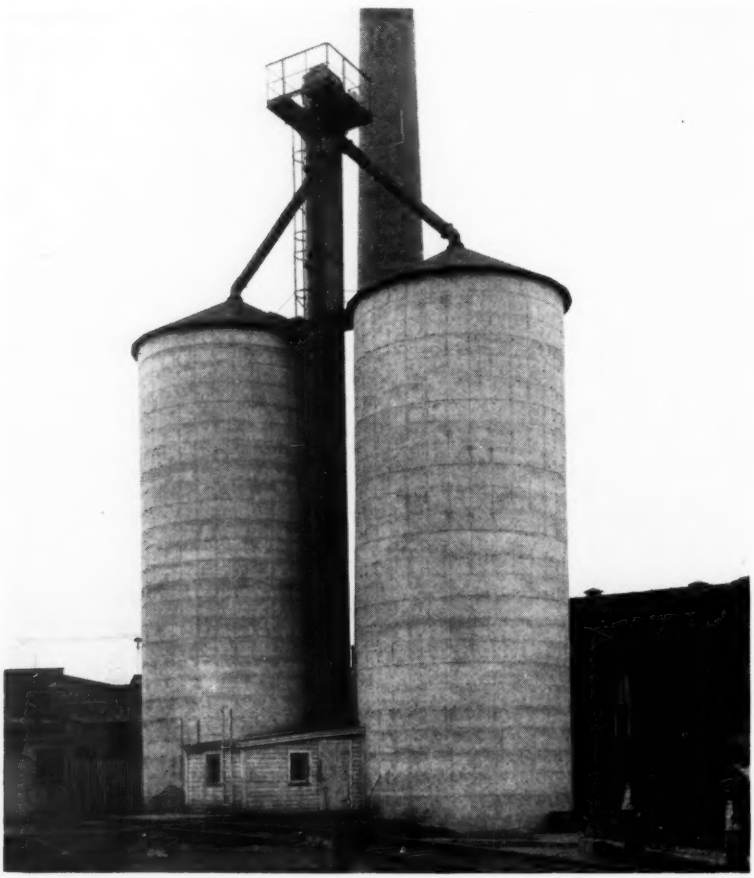


Fig. 1. For medium and small size industrial power plants, the silo type coal storage bin presents the advantages of small area requirements, coal dust is confined, fire hazard is low, comparatively uniform time of coal storage when coal for use is drawn off from bottom, surplus of deliveries over current needs can be readily stored by means of bucket elevator, provision of reclaiming system not necessary

Coal Selection

To burn coal economically is to accomplish the conversion of the latent heat units in the coal into heat energy in the water and steam in the boiler, with the least expenditure of capital for fuel, fuel handling equipment and preparation, and for burning equipment and its operation. Therefore, in the selection of coal for a particular installation the following data should be compiled, for which forms are available from the National Association of Purchasing Agents, Inc.:

Handling and firing equipment: Plant name, location and railroad, siding or dock, type of delivery equipment, tons of coal normally stored (active and inactive), tons of additional coal that can be stored without extra handling cost, unloading capacity (tons per hour), delivering equipment (boat, car, truck), coal handling facilities (crane from car or boat to bin, fixed conveyor to bin, fixed conveyor to stoker or pulverizer, portable conveyor, hand from bottom car, hand over side of car, method of storing, other facilities), coal crushers (make and type), coal pulverizers (make and type), method of firing (pulverized coal burner, make and type, stoker, make and type, hand), scales (coal, ash), ash disposal facilities, and clinker grinder.

Boiler dimensions and equipment: Boilers (type of and number), methods of baffling, steam pressure and temperatures, design rating (lb steam per hr), clearance in inches above bridgewall, heating surface in sq ft (water covered, water walls, superheater, economizer or air preheater), feedwater heater (type), average furnace (width, depth, height, Btu heat release) projected grate area, type of grates or bottom, volume of combus-

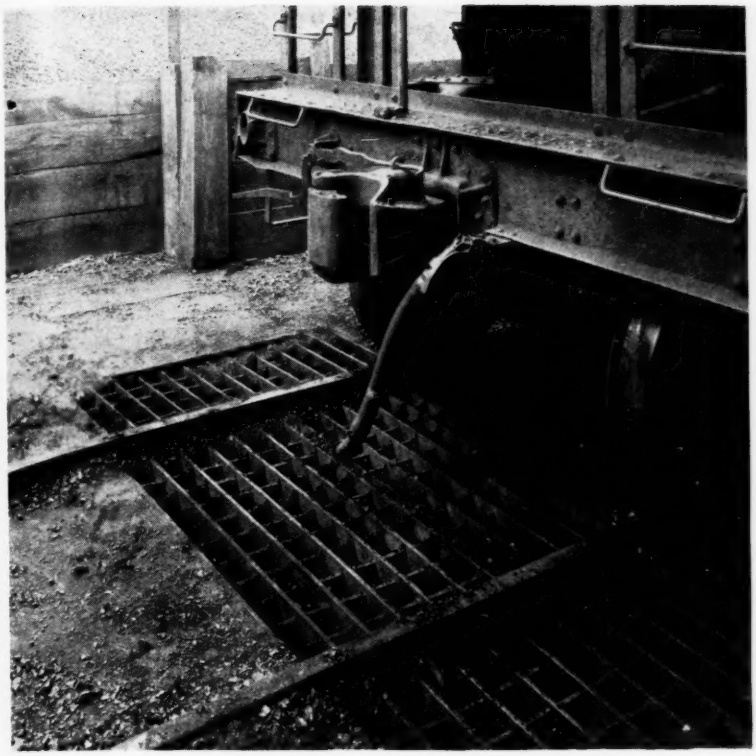


Fig. 2. Coal delivered to plant having receiving hopper protected by grating, such as shown here, must have maximum size specified and should be delivered in hopper bottom cars

tion space, type of furnace walls, radiant heating surface, make and type of soot blowers, air supply (gages, area of openings, type of control), make and type of draft fans, stacks (number, height above boiler room floor, diameter at top).

Operating information: Tons of coal consumed per month, seasonal variations in consumption, coal handling cost per ton (active, stored) weight of ash per day, ash disposal cost per ton, ash disposal method, condition of furnace, boiler scale conditions, burning rate in each boiler (average lb coal per hr, maximum lb coal per hr, hours maximum load, hours banked), temperatures, average, minimum, maximum, normal in deg F (number of boilers on line, feedwater, air supply, furnace, stack), furnace draft, CO_2 per cent, actual evaporation in lb water per lb coal, per cent efficiency, labor (total number of men required to operate boilers per day, number of shifts, number of firemen per shift).

Coal experience: Sizes of coal suitable, size preferred, minimum allowable ash softening temperature, description of desired coal (seam, shipping point or mine, moisture, volatile dry basis, fixed carbon dry basis, ash dry basis, sulphur dry basis, Btu dry basis, ash softening temperature, grindability minimum index and maximum moisture, washed or not, treated or not), burning characteristics (coking, caking, free-burning), does flame impinge on water cooled surface of boiler and where, per cent combustible in ash, troubles (lack of steam, clinker, smoke, slagging, heating in storage at normal operation, freezing, dust, fly ash), coal satisfactory, coal not satisfactory, coal preferred.

With all this plant data available, the engineer is in position to confer with coal dealers and arrange with them to furnish a trial shipment of coal which nearest fits the desired specifications. The data required with each sample shipment would be: name of shipper, name of seller, name of mine, seam, capacity of mine, preparation of coal, location of mine, mining district, coal price, freight rate, delivered cost, cost per million Btu, number of cars shipped, size condition, analysis (as received and dry).

Coal thus received should be given a thorough test under operating conditions and a record kept of its performance. The data recorded during tests on the various samples used should include: Boiler number tested, average rating, 15 minute peak load, steam pressure and temperature, temperature of air supply, comment on rating, pulverizer or stoker (condition, power required, kilowatt-hours per ton), foreign material separated from coal, condition of furnace before and after run, condition of bottom, walls and tubes, actual and from-and-at evaporation, character of ash (per cent combustible, type of clinker), CO_2 in flue gas, steam cost (coal, power to prepare total cost per 1000 lb steam), coal classified (excellent, good, acceptable, unsuitable).

It is well recognized that the man responsible for purchasing coal must depend upon the reliability and completeness of information, such as outlined above, gathered by the operating group and field engineers who can pass judgment on conditions at the mines whose products are being considered for purchase. In times of emergencies, coal buyers may be forced to depend upon spot purchases but coal purchase on contract is recognized as the better practice. It is sound business to pay prices that will guarantee sources of supply and will contribute to the stability of the coal industry.

This year, particularly, with coal in storage at low levels, coal prices are almost certain to rise, transportation charges are likely to follow the trend toward higher levels, and a tendency toward the marketing of lower grades of coal, the industrial buyer should fortify himself as far as possible against fuel shortage, price fluctuations and varying coal quality. This can best be done by purchasing on yearly contract regular monthly deliveries of coal of specified quality and building up throughout the year a substantial reserve in storage.

TAKE IT FOR GRANTED

By LYNE S. METCALFE

To the already considerable list of motion pictures produced and circulated by power companies has recently been added a 23-minute (screen time) picture, "Take It For Granted." This movie was produced by The Jam Handy Organization, Detroit, for The New England Power Co., and is being widely shown in the region served by that utility.

The primary purpose of the picture, which has been professionally made in every respect, is to reveal, in dramatic and graphic form, with on-film commentary, the part that dependable electric power plays in the home life and industry of the area served by the New England plants.

In making the production, commercialism has been subordinated to stress the educational-information aspects. It is recognized that, as elsewhere consumers of power in this region "take it all for granted," often little realizing what it takes to keep the power coming, without interruption, and in needed quantities.

Free showings are being made before interested groups, schools, clubs, churches, associations. For details as to showings, write to John I. Ahern, New England Power Co., 441 Stuart St., Boston, Mass.

Selecting and Installing Thermocouple Leadwires

Importance of properly installing leadwires . . . Improper selection of leadwires can be costly . . . Technical considerations . . . Wire conductors . . . Insulation . . . Types of extension leadwires available . . . Testing leadwires . . . The installation of leadwires

By C. C. ROBERTS and C. A. VOGELSANG, *Brown Instrument Co.*

THE ACCURACY of any pyrometer system can be no better than the inherent precision of its components. Generally, the user will exercise the utmost care in the selection of an indicating or recording instrument with a high degree of accuracy or a precision thermocouple, but will frequently neglect the all-important factor of the wiring between the two.

The temperature indication in pyrometry is obtained from the measurement of the emf developed by a thermocouple. This emf is determined by the temperature differential between the hot and cold junctions of the thermocouple. If the thermoelectric circuit were confined to thermocouple proper, variations in the temperature at the old junction (terminal head) would introduce an intolerable error. However, when suitable extension leadwire is used to extend the thermocouple to the instrument and thus locate the cold junction at a point where changes in its temperature can be easily and accurately compensated, the required degree of precision can be attained.

When extension leadwires are used (as they are in practically all pyrometer installations today) they become a part of the thermoelectric circuit and the thermocouple actually consists of the extension leadwires plus the thermocouple itself. Hence, the thermoelectric characteristics of the metals used in the extension leadwires are as vital as those of the thermocouple proper.

The importance of providing protection for the thermocouple proper is appreciated by all experienced users of such devices. In like manner, the proper protection of the extension leadwire is of equal, if not greater, importance, since it is not generally an expendable part of the installation and frequently costs as much as, or more, than the thermocouples and instruments combined.

Fig. 1. Checking the thermoelectric characteristics of extension leadwires at the Brown Instrument Co. plant. Samples of the wires whose ends have been welded together can be seen protruding from the small furnace, the temperature of which is kept at a known value. The opposite ends of the sample can be seen as inserted into the ice water thermos type container

Improper Selection of Leadwire Can Be Costly

In all instances, choice, layout and installation of leadwires are important and these factors become increasingly so as the number and lengths of the leadwires necessary to an installation become greater. In installatians, such as brick yards, engine testing laboratories, steel mills, blast furnaces, and coke ovens, where extension leadwires are used under wide ambient temperature conditions and subject to many deleterious factors, such as weather, corrosive atmospheres and the like, the possibility of future maintenance difficulties and operational inaccuracies are multiplied.

Inasmuch as the emf generated by a thermocouple is, at the most, only about 50 millivolts (0.050 v), very minute leakage or galvanic action can produce serious inaccuracies in the temperature indications by changing the emf applied to the instrument. Therefore, the moisture-resistant qualities of insulation, which guard against the possibilities of leakage or galvanic action, are primary factors to consider. The weather, heat, and corrosive atmosphere resistant qualities are of equal importance in forestalling leakage, direct shorts, and grounds.

An example of the costliness of the loss entailed when insufficient consideration is given to the insulation qualities of thermocouple leadwires was seen in a large installation in the Gulf Region. This particular installation comprised a number of widely separated test points with thermocouples located at each. The leadwires from each thermocouple were brought to a central point where an indicating instrument could be selectively switched to each. Because of the number of test points involved, the length of leadwires, and the fact that the wiring was embedded in the concrete flooring and walls before the building construction was completed, the cost of the installation

was many times that of the instrument itself.

The instrument manufacturer's recommendation as to the type of leadwire insulation specifically required for this installation was disregarded and a type of insulation selected by the customer's engineer was used. After the installation was completed and the instrument system was put in operation, it was found that considerable inaccuracies existed in the temperature indications of the instruments. The erroneous indications became progressively worse until the entire system was useless. After it had been determined that neither the instrument nor the various thermocouples were at fault, it became obvious that the trouble lay in the concealed extension leads. Diligent searching and testing revealed the fact that the high humidity prevalent in the Gulf Region had introduced moisture into the insulation of the extension leads. As a result, the insulation impregnant became an electrolyte when wet and a galvanic effect was produced between the two dissimilar metals comprising the conductors. Inasmuch as the extension leads were embedded in the building structure, it was a major operation to replace them. Consequently, a $200,000 loss resulted from the uselessness of the original leadwire installation, a loss which could easily have been avoided had the proper moisture-resistant insulation been used, as originally recommended.

Fig. 2. View of part of the large stock of thermocouple leadwire kept on hand at the Brown Instrument Company plant

Technical Considerations

For the purpose of clarity, the technical aspects of extension leadwires will be divided into two general parts: Wire, and Insulation. The considerations for each in relation to a specific installation are entirely independent of one another. Therefore, by fulfilling the requirements as to the type of wire *and* the type of insulation, the proper extension leads for the specific case at hand can be ascertained.

As was previously stated, the emf developed by a thermocouple is determined by the temperature differential between the hot and cold junctions of the thermocouple. Since the extension leadwires are intended to extend the cold junction point to the end of the extension leadwires, they *must* have thermoelectric characteristics which conform to those of the actual thermocouple wires and the extension leads, there would be a thermoelectric effect which would result in erroneous readings.

Wire Conductors

While in most cases the same metals are used in the extension leadwires as are used for the thermocouple wires themselves, there are times when this is economically impractical. However, if the thermoelectric characteristics of the extension leadwires and those of the thermocouple itself conform, the same results are obtained, regardless of the materials used. For example, it is economically prohibitive and unnecessary to use Platinum-Platinum Rhodium extension leadwires with a Platinum-Platinum Rhodium (QR or HER) thermocouple. Consequently, a cheaper combination of metals (such as copper-copper nickel) whose thermoelectric characteristics conform within the required limits, is used to obtain entirely satisfactory results.

Insofar as the size or gage of wire is concerned, there is only one factor of relative importance to be considered, and that is the effect of external resistance upon the indicating instrument. Where the calibrated galvanometer (millivoltmeter) type of instrument is used, the resistance of the external leads should be as low as practical, especially where multiple measurements are made from thermocouple located at greatly varying distances from the instrument. Usually No. 14 B & S gage wire is used. Where the galvanometer actuated potentiometer type of instrument is used, somewhat smaller wire can generally be used since the degree of accuracy is not dependent upon the external resistance in the circuit. As a rule, No. 16 B & S gage wire is used. Where an instrument, such as the Brown ElectroniK, is used, external resistance has negligible effect upon its operative characteristics and extension leads as small or smaller than No. 20 B & S gage can be used.

For the majority of installations, solid conductor wire is used; however, where the thermocouple is moved from one application to another, necessitating flexible extension leadwires, the stranded type of conductor must be used in order to avoid frequent breakage.

Insulation

The insulation surrounding the extension leadwire conductors must act not only as a dielectric (have high electrical resistance) between the two conductors and between the two conductors and ground, but must act as a protective covering to exclude the entrance or absorption of any deleterious materials which would give an unfavorable electrical reaction.

Primarily, the insulation must be a good dielectric. It is of the utmost importance that the dielectric strength (insulating qualities) remain effective throughout any conditions of temperature, humidity, corrosive atmosphere, etc., to which the leadwires may be subjected. For this reason, various kinds of material are used for insulation, the choice of which is determined by the condition prevalent at some particular installation. For example, it is often necessary for the extension leadwire insulation to withstand weathering in such open air installations as brick or coke ovens. In such cases, the insulation must be able to withstand both excessive wetting and excessive baking by the sun without any serious deterioration in the dielectric strength of the insulation. In installations where the leadwire is not subject to weather deterioration, other

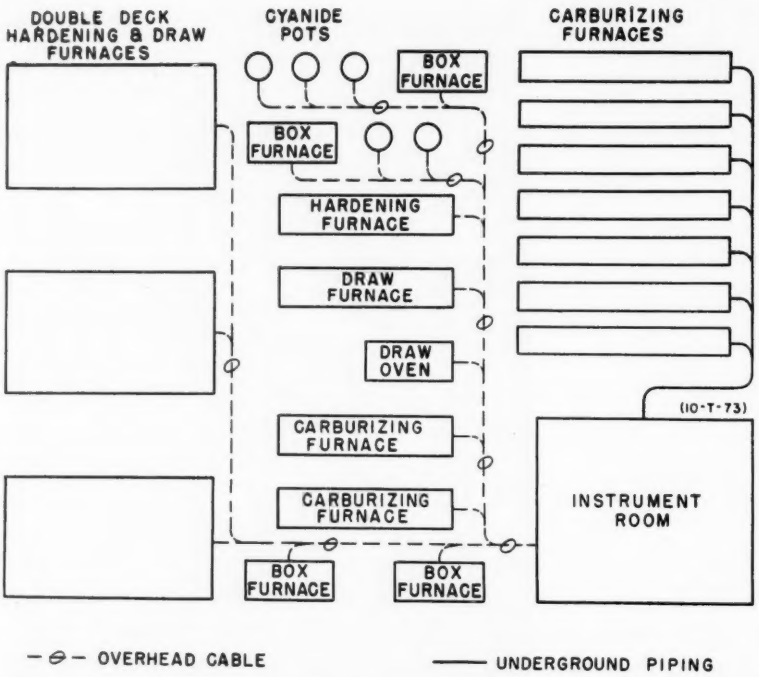


Fig. 3. Layout representing the extension leadwire wiring in the Gear and Axle Department at the River Rouge Plant of the Ford Motor Co. Part of the wiring is underground, protected by lead conduit. The hardening and carburizing furnaces use No. 14 copper-constantan asbestos covered leadwires and chomel-alumel thermocouples. The longest leadwire is approximately 300 ft long

detrimental conditions, such as steam, flame, corrosive atmosphere, and heat must be considered insofar as the insulation is concerned, and an insulation capable of withstanding these conditions selected.

Examination of a piece of leadwire, shows that there are two, or sometimes three layers of insulation. The insulation directly around the conductors is a protective covering with a high dielectric strength and provides the primary electrical insulation. The outer insulation binds the two conductors into cable form and furnishes electrical isolation from the conduit or ground and mechanical and chemical protection. Both inner and the outer insulations should be of a material which is resistant to both physical and chemical deterioration so that the dielectric properties of the leadwire remain effective. This is especially important in installations where it is difficult to replace the leadwire if trouble should develop.

To protect the extension leadwires from mechanical wear and tear, when necessary, a metal protection is used. This is generally in the form of either iron or steel conduit or a lead sheath. The use of lead sheath is desirable in installations where excessive moisture or corrosive atmosphere is encountered. The use of conduit is requisite when there is danger of mechanical abrasion or penetration which could result in the destruction of the insulation.

Extension leadwire is available both in different kinds of insulation and in different metal conductors. In this way, extension leadwire with thermoelectric properties to conform to any thermocouple *and* with insulation to fit any installation condition is available. The following list of the most commonly used thermocouples shows the kinds and sizes of the extension leadwire which are supplied:

IRON-CONSTANTAN (IC) THERMOCOUPLES — 14-gage solid conductors, 16-gage solid or stranded conductors consisting of a positive conductor of iron and a negative conductor of constantan.

CHROMEL-ALUMEL (MA) THERMOCOUPLES—15-gage solid conductor 16-gage solid or stranded conductors consisting of a positive conductor of copper and negative conductor of constantan. Also, 14-gage solid conductors consisting of a positive conductor of chromel and a negative conductor of alumel.

Because of the cost of chromel-alumel leadwire, copper-constantan leadwire, which is less expensive, is used for installations involving thermocouple terminal head temperature up to about 250 F. Above this temperature, the relationship between the temperature and the developed emf for copper-constantan becomes increasingly different from that of chromel-alumel, thus making it necessary to use the more costly chromel-alumel combination to avoid serious errors in the temperature indications.

PLATINUM-PLATINUM RHODIUM THERMOCOUPLES — 16-gage solid or stranded conductors consisting of a positive conductor of copper and a negative conductor made of a special alloy. (Leadwires of the special alloy and copper were developed to be equivalent in their thermoelectric characteristics with Platinum-Platinum Rhodium. This was necessary inasmuch as Platinum is a noble metal and consequently quite costly.)

COPPER-CONSTANTAN (CC) THERMOCOUPLES — 20-gage conductors consisting of a positive conductor of copper and a negative conductor of constantan.

The foregoing list of conductors is available with different kinds of insulation, so that specific installation conditions can be met. Not all conductors are available in all types of insulation, inasmuch as industrial requirements are such that each particular type of thermocouple will not be used subject to all conditions of exposure. The following list shows the types of insulation available, together with the general conditions under which they should be used:

POLYVINYL THERMOPLASTIC — General purpose insulation for use in temperature conditions under 140 F. This insulation is greatly resistant to deterioration and moisture.

FELTED WAX-IMPREGNATED ASBESTOS —High temperature, flame and moisture-resistant insulation. Used generally where the temperature ranges from 140 F to 400 F. The asbestos, impregnated with a flame and moisture-proof wax, forms an insulation suitable for installations wherein flames, steam, and high temperatures are encountered. It also has considerable resistance to moisture.

RUBBER—Flexible moisture-rseistant insulation. Generally used where flexibility is the paramount factor, such as for portable use, and where the temperature does not exceed 110 F.

Since it is essential that the polarity be observed in connecting extension leadwire, the electrical polarity of each conductor is often identified by a color. The negative conductor, for example, can always be identified by its red coding.

Testing Leadwire

To assure the utmost in accuracy and service, all extension leadwire is rigidly tested for conformance to various specifications. Specifications relative to the thermoelectric characteristics of the extension leadwires are extremely important insofar as the final accuracy of the pyrometer installation is concerned. Testing can be done by welding the two conductors together at one end, thus forming the hot junction of a thermocouple. The hot junction thus formed is then immersed in a hot oil bath whose temperature is precisely meas-

(Continued on page 124)

The Gas Turbine Power Plant—VI

Continuation of the first textbook on how to design and build a complete gas turbine power plant today . . . Gas turbine materials . . . Conditions under which materials in gas turbines have to operate . . . Temperatures involved . . . Principal problems . . . Oxidation . . . Reduction of strength . . . Thermal expansion . . . High cost and difficulty of processing . . . Analysis of important high temperature alloys . . . The coal fired gas turbine . . . Major problems in burning coal . . . Removal of fly ash . . . Methods of controlling coal fired gas turbine plant . . . Fly ash separation . . . Pilot plant tests

By JOHN I. YELLOTT

Director of Research, Locomotive Development Committee, Bituminous Coal Research, Inc.

THE GAS TURBINE POWER PLANT makes such exacting demands upon the materials used in its construction that its development could not proceed beyond a relatively elementary stage until entirely new heat-resisting alloys were made available. In the turbine itself, the blades in the first stages are subjected to a combination of elevated temperature and high stress which can be withstood only by alloys of truly remarkable quality. The metal of the flame tube in the combustor, while it is not called upon for high strength, must resist corrosion and scaling at temperatures up to 2000 F. Ducts and transition pieces between the components must sustain a combination of internal pressure, thermal expansion, and relatively large diameter which requires great ingenuity on the part of the designer. High turbine inlet temperatures are essential to good efficiency, and it was not until the war-developed alloys became available that the gas turbine power plant could assume wide importance as a prime mover.

A. Gas Turbine Materials

A comprehensive discussion of gas turbine metallurgy would require far more space than is available in this series. A relatively brief summary of the major problems will be given, however, so that the difficulties inherent in high temperature operation can be appreciated. The references listed in the bibliography have been freely drawn upon, and the serious student would do well to consult them.

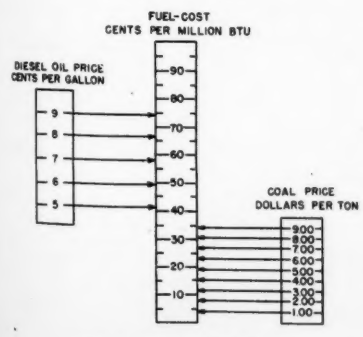


Fig. 1. Coal vs Oil Price

In ordinary steam power plant practice, temperatures above 950 F are rarely encountered, and the metallurgical problems are not particularly severe. The gas turbine presents a very different picture, since it must use inlet temperatures which range upwards from the 1100 F used in the Brown Boveri designs to the 1500 and 1600 F in aircraft turbo-jet plants. The principal problems come under four main headings:

(a) OXIDATION—All metals become less resistant to corrosion as their temperature increases.

(b) REDUCTION OF STRENGTH—Ability to sustain stress, to resist fracture from fatigue, and to maintain critical dimensions over long periods of time, are all reduced rapidly as operating temperatures pass 1200 F.

(c) THERMAL EXPANSION — Virtually all heat-resistant alloys have higher coefficients of expansion than ordinary carbon steels, which, combined with high temperature differentials, result in large changes in dimensions.

(d) HIGH COST AND DIFFICULTY IN PROCESSING—Addition of the alloying materials which cause steel to gain desirable high temperature properties results in a many-fold increase in cost. Ordinary machining practices must be replaced by precise heat treatment, carefully controlled forging, precision casting, etc.

The significance of operating life is entirely different at the high temperatures which must be used in gas turbines. Stresses which can be withstood indefinitely at low temperatures will cause failure after a few thousand hours under load at high temperature. Time at operating temperature largely determines the material which can be used and the stresses to which they can be loaded. A continuous growth or creep must be anticipated, which makes imperative the provision of adequate clearances.

Corrosion resistance was one of the first desirable characteristics to be achieved by ferrous metallurgists. "Iron rusts" is a statement which has been known since the first blacksmith watched scale form on red-hot iron. Iron and oxygen invariably combine, and with an affinity which increases rapidly with temperature, unless preventive steps are taken. Table I shows the rate at which ordinary low-carbon steel oxidizes at temperatures encountered in gas turbines (1):

TABLE 1. Oxidation of ½-Inch Cubes of Low-Carbon Steel

Temperature °F	Temperature °C	Loss of Weight in One Week Per Cent
750	400	0.2
1020	550	0.5
1200	650	3.3
1380	750	15.0
1560	850	37.0
1830	1000	100.0

In other words, oxidation proceeds so rapidly that ordinary carbon steels cannot be used at temperatures above 1000 F. Fortunately, high-temperature oxidation can be reduced to a negligible amount by the addition of chromium in amounts above 20%. The same series of tests (2) which yielded the data of Table I revealed that the loss in weight at 1830 F is reduced from 42% in 48 hours for un-alloyed low-carbon steel to less than 1% when chromium is added in percentages of 20 or greater. Tests conducted at Purdue University for the Locomotive Development Committee by W. E. Fontaine have indicated that corrosion of Type 310, 25% chromium, 20% nickel steel is very slight in air at 2000 F, even when some sulfur dioxide is present.

It is believed that the oxidation resistance of high chromium steels arises from the immediate formation of a thin, tenacious, self-healing film of chromium-iron oxide as soon as the metal is exposed to air. Excellent corrosion and oxidation resistance is also possessed by other families of

All rights of re-publication reserved by author.

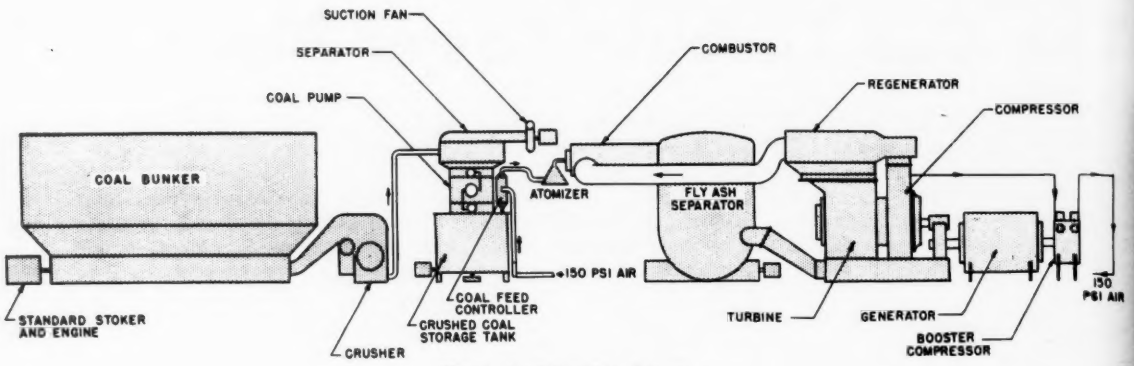


Fig. 2. Coal Handling System

alloys, such as the high nickel materials known as Monel and Inconel. Relatively low cost and good working properties make the high chromium alloys particularly desirable, however. An excellent summary of their properties is given in reference (3) in the attached bibliography. Table II gives typical analyses of a number of high-temperature alloys.

Perhaps the most difficult problem which has yet confronted metallurgists is the development of metals which retain their strength at temperatures above 1000 F. Among the factors which must be considered in selecting gas turbine blade and disc material, for example, are stress-to-rupture strength, creep resistance, fatigue or endurance strength, and damping.

Stress-to-rupture is a relatively new concept. Any good steel will carry a relatively heavy unit stress for a short time without failure. As the stress is increased, and particularly as the temperature goes up, the steel will show a very disturbing tendency to fail after a certain time under load. Thus short-time tensile tests may be misleading, because they indicate an ability to support a stress which will actually cause failure if it is maintained for a long period of time. Temperatures above 1100 F cause marked reductions in the stress-to-rupture values which can safely be used for heavily loaded elements.

Creep is the gradual and continuous elongation which occurs when metals are heavily loaded at elevated temperatures. Once again, any metal will elongate when a load is applied to it, but this stretching is spring-like and disappears when the load is removed. Creep, however, is a permanent deformation which increases continuously as long as the load is applied. The extent of the elongation depends upon the unit stress, the temperature, and the nature of the metal. In aircraft gas turbine work, 1% creep in 10,000 hours would not be excessive, while 1% in 100,000 hours would be more suitable for a locomotive or a power plant gas turbine.

Creep is determined by measuring the elongation of specimens which are held for a long period of time at a controlled temperature and continuously subjected to the desired load. Unfortunately, accelerated creep tests have not proven reliable, and at least 1000 hours must be invested in a test before it can be considered significant. The addition of chromium and nickel to ordinary carbon steel is very beneficial in improving its creep strength.

Fatigue is the term applied to a failure at a relatively low stress caused by an excessively large number of reversals of load. Fatigue is a misleading word, for metals do not get "tired," nor do they regain strength when rested. Endurance limit (1, p. 144) is a more descriptive term, which may be defined as that stress below which the material will not fail, even if it is subjected to an infinite number of stress reversals.

Damping is related to fatigue. Damping refers to the capacity of a material for gradually eliminating vibration through the dissipation of energy by internal friction. Damping is a valuable property in turbine blade material, for example, where vibration is particularly likely to occur. A vibrating turbine bucket can undergo a tremendous number of stress reversals, and reach or exceed its endurance limit in a short time. If the blade material has high damping capacity, the vibrations may be eliminated before fatigue failure can occur. Unfortunately, most high-temperature alloys do not possess this property to any great degree (7).

When the war made the development of jet engines a matter of necessity, research on high-temperature metallurgy was tremendously accelerated. Most of the information obtained in this program was restricted until 1947. However, a number of recent publications have revealed some of the great advances which have occurred since 1941 in the art of high-temperature alloys. Improvement of stress-to-rupture strength and creep resistance at very high temperatures is the major achievement.

The best pre-war materials were the chromium-nickel alloy steels,

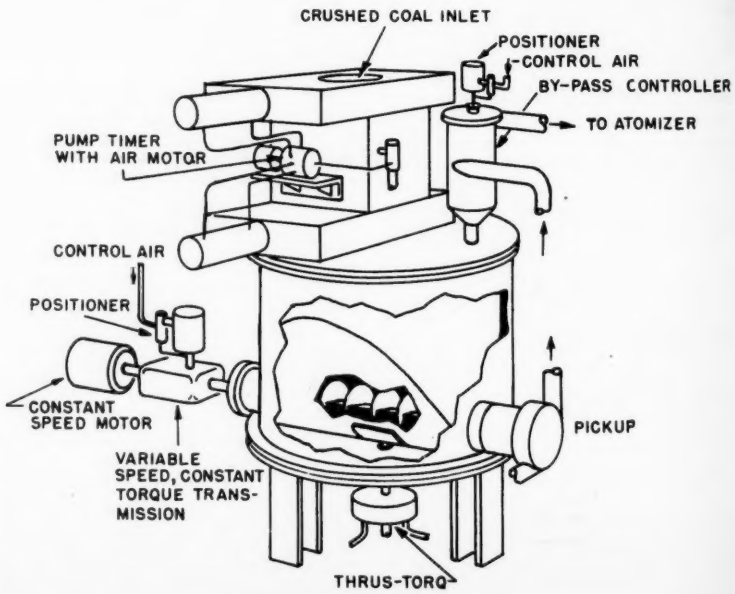


Fig. 3. Coal Supply System

Keeps His Bearings

SUN LUBRICANT . . .

Keeps Compressor's Main Bearings and Other Parts Like New for 20,000 Hours

The 400 horsepower, V-type, diesel-driven compressor in an Eastern shipyard operates normally on a 24-hour-a-day schedule. It has been lubricated with a Sun "Job Proved" oil from the day it was installed, and there has never been any lubrication trouble.

After 20,640 hours of almost continuous operation, the compressor was torn down for inspection. The main bearings, shown above, were checked and found to be in fine condition, with less than normal wear. All other parts were in the same state—practically as good as new.

The protection given to this compressor is typical of the results obtained in hundreds of plants with Sun "Job Proved" lubricants. For every type of modern power plant equipment, there's a Sun oil that's designed to give long, trouble-free service.

To reduce maintenance costs and to keep your diesels, turbines, compressors and other machines in operation longer, let Sun Engineers prescribe the correct lubricants. Call your nearest Sun office, or write Department PP9.

SUN OIL COMPANY • *Philadelphia 3, Pa.*
In Canada: Sun Oil Company, Ltd. — Toronto and Montreal

SUN
SUNOCO

INDUSTRIAL PRODUCTS

Table II. Typical analyses of important high-temperature alloys

Designation of Alloy	ELEMENTS											
	Cr	Ni	Co	C	Cb	Ti	W	Si	Mo	Mu	Cu	Fe
347 (18-8 Cb)	18.50	11.00	—	0.07	0.70	—	—	0.50	—	1.00	—	B*
310 (25-20)	25.00	20.50	—	0.12	—	—	—	1.75	—	1.25	—	B
19-9 DL	19.00	9.00	—	0.30	0.40	0.35	1.25	0.50	1.25	0.75	—	B
19-9 W-Mo	19.00	9.00	—	0.10	0.40	0.35	1.25	—	0.40	0.60	—	B
S-588	19.38	19.76	—	0.45	—	—	4.07	0.37	4.16	0.48	—	B
S-590	20.88	19.42	19.31	0.43	3.92	—	3.93	0.66	4.33	1.65	—	B
S-816 (Timken)	19.84	20.17	42.28	0.38	3.77	—	4.26	0.39	4.30	0.49	—	4.09
16-25-6 (Timken)	16.00	25.00	—	0.12	—	—	—	1.00	6.00	2.00	—	B
N-155	21.00	20.00	20.00	0.15	—	—	2.00	0.50	3.00	1.00	—	B
Vitallium	27.00	2.00	70.80	0.20	—	—	—	—	6.00	—	—	O
Hastelloy C	15.00	60.90	—	0.10	—	—	2.00	—	17.00	—	—	5.00
Hastelloy B	—	66.00	—	0.10	—	—	—	—	28.00	—	—	5.00
K-42-B	18.00	42.00	22.00	0.05	—	2.20	—	0.70	0.70	—	Al 0.20	14.00
Inconel	13.50	78.00	—	0.09	—	—	—	0.30	—	0.75	0.20	6.70
Monel	—	67.00	—	—	—	—	—	—	—	1.00	30.00	1.70
Discalloy	13.00	25.00	—	0.05	—	1.80	—	0.70	3.00	0.70	Al 0.20	55.00
Refractalloy 26	18.00	37.00	20.00	0.05	—	2.80	—	0.70	3.00	0.70	Al 0.20	18.00
Stayblade	20.00	8.00	—	0.20	—	1.20	—	—	—	—	—	B
Nimonic 80	21.00	75.00	—	—	—	2.50	—	—	—	—	Al 0.60	—

which are discussed in detail in reference (3). Reference (4), by C. T. Evans, Jr., Chief Metallurgist of the Elliott Co., is one of the first post-war publications of importance, and the symposium on "super alloys" (5) gives an excellent discussion of many of the materials which gave good service in turbo-superchargers and early jet engines. J. B. Henry, Jr., of Allegheny-Ludlum Steel Corp., (6), has given a valuable summary of the characteristics of three notable new alloys which will be used in some of the first commercial gas turbines.

The more common stainless steels are identified by type numbers, which were assigned by the American Iron and Steel Institute, such as Type 310, commonly known as "25-30", for a steel containing less than 0.25% C, less than 2.0% Mn, less than 2.0% Si, less than 0.03% S, less than 0.35% P, between 24 and 26% Cr, between 19.0 and 22.0% Ni. Because of its excellent resistance to oxidation and respectable strength at high temperature, Type 310 is widely used for combustion chambers. Where lower temperatures are encountered, Type 347, known as "stabilized 18 and 8" is frequently employed. This alloy is made with the same limitations on carbon and other minor elements which were listed for Type 310, but it contains only 18% Cr and 8% Ni, with Columbium present in at least eight times the carbon percentage.

These two alloys were among the best of the pre-war high-temperature materials, but they did not possess enough creep strength or stress-rupture strength above 1100 F to be useful as gas turbine blade or disc material.

A close relative to the familiar chrome-nickel steels is the alloy known as 19-9 DL. This material is useful up to 1200 F, and was used in the blading of the Elliott marine gas turbine plant. From the quantitative point of view, the alloy developed by the Timken Company (1) under the designation 16-25-6 (16% Cr, 25% Ni, 6% Mo) stands far ahead of any other metal, for it was used in the great majority of the turbo-supercharger rotors produced during the war. A detailed account of the development and properties of this alloy are given by Martin Fleischmann in reference (7).

Alloys containing large amounts of cobalt and generally similar to the widely known Vitallium (28% Cr, 2% Ni, 6% Mo, 64% Co) have demonstrated combinations of strength, endurance and creep resistance which make them useful at temperatures up to 1500 F. Because of their extreme hardness (they are members of the Stellite family), they cannot be machined by ordinary methods. Precision casting, using the lost wax process, was brought to a high stage of development in the production of the tremendous numbers of blades required for aircraft turbo-super-chargers.

Among the most promising newer alloys, developed in the program of the Office of Scientific Research and Development during the war, are the three designated as S-588, S-590, and S-816 (6). The common characteristics of these alloys is the use of approximately 20% Cr, 20% Ni, and 4% each of Mo, W (tungsten), and Cb (Columbium). In addition, the cobalt percentage increases from zero in S-588 to 20% in S-590, and 42% in S-816. Very small amounts of car-

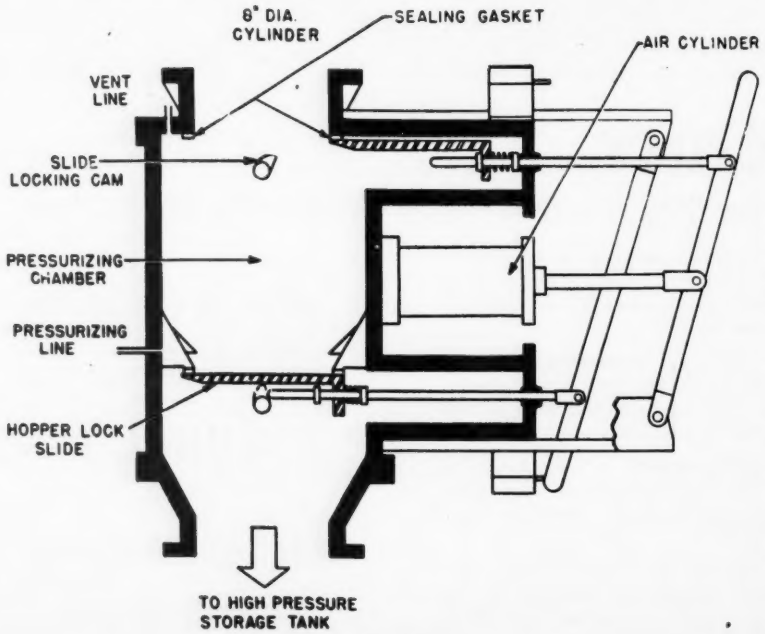


Fig. 4. Coal Pump

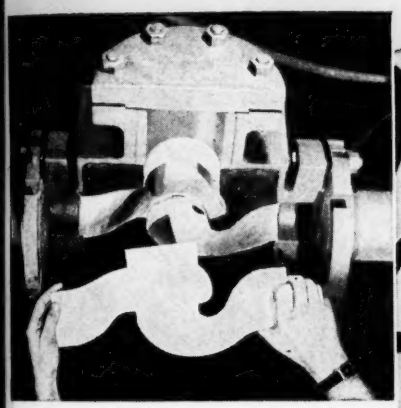
PROVED! More Flow, Less Pressure Loss *with* NEW Edward STEEL VALVE DESIGNS

To be *sure* that Edward engineers were on the right track in their efforts to cut pressure loss and wear-producing turbulence and to increase flow in new steel valve designs, the Edward laboratories set up an entire new set of research procedures and developed a whole range of new test equipment, much of it not duplicated anywhere.

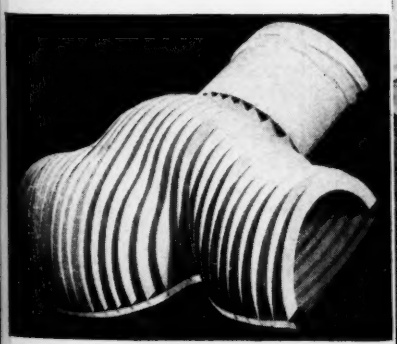
So there's no guessing in the statement that you get up to 30 per cent more flow through new Edward steel valve designs. There's proof aplenty—the evidence of actual field operation and cross-checked laboratory tests . . . the cold facts of pure mathematics, and even the convincing testimony of visual pre-testing.

Here you see plaster casts shaped by half-section plastic valve models. Each model, molded in a steel box and frozen hard, has been flow-tested to develop ideal flow contours. To compute flow test results Edward technicians even developed completely new slide rules, like the one shown. The plaster casts serve as masters from which sectional models and then the actual patterns for Edward valve castings are developed.

No valve series has ever been designed with more extensive flow research . . on no other valves is there more proven flow data.



Half section super-streamlined Edward globe valve of plastic is used in flow tests. After ideal contours for high volume and minimum turbulence are established, casts are made of flow passages.



From actual plaster casts, checked against mass of flow data, model cross section templates are built. These guide design of patterns for Edward steel valve body castings.

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO.

EAST CHICAGO INDIANA

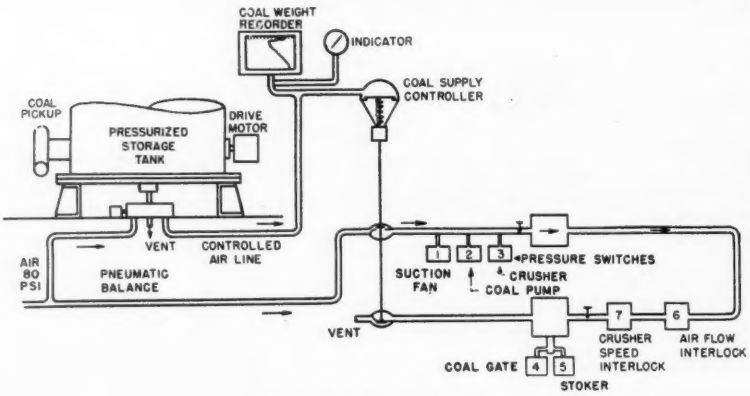


Fig. 5. Coal Supply Control

bon, silicon, and manganese are also present. These alloys are scale-free at gas turbine temperatures, because of their chromium content, and they possess exceptional strength even at 1500 F.

To conclude this brief summary, metals of the "super-alloy" group are now available, which give every indication of being quite suitable for long-time operation at 1400 F with stresses which permit reasonable gas turbine designs. These metals are expensive, and they require great care in fabrication, but they can be formed into discs, blades and diaphrams for gas turbines. Development is continuing, and better metals will be developed.

The importance of good temperature control on a gas turbine combustor cannot be over-emphasized, for excessive temperature can so weaken even the best material that it becomes an easy prey to creep and rupture.

Attention is being given to the use of ceramic materials for protective coatings and even for turbine blades and discs. The Germans pioneered in this field, because they did not possess the relatively rare metals needed to give high-temperature strength to carbon steel. The obvious difficulties with ceramics for highly stressed parts are brittleness and relatively low strength, but these may be offset to some extent by lightness and high melting temperature.

Cooling of highly stressed discs, nozzles, and blades is another expedient which was ingeniously applied by the Germans in their jet engines. The use of hollow blades and nozzles, cooling fans on rotors, and such devices, enabled them to employ low alloy and even carbon steel in components for which high-grade alloys were considered essential by the Allies. An outstanding example of cooling in American turbine design is the Allis-Chalmers turbine, which has successfully operated at 1500 F at the Naval Engineering Experiment Station in Annapolis.

B. The Coal-Fired Gas Turbine

This series has dealt principally with the components of gas turbine power plants, with little attention to the nature of the fuels which they can burn. Liquid and gaseous fuels have been employed successfully, since they offer little difficulty in preparation, combustion, or control. The economics of fuels in the United States vary widely with geographical location, but in most sections of the country bituminous coal is the cheapest source of energy. The most useful common denominator for comparison of fuel costs is their price in cents per million Btu, which can be approximated for coal and Diesel oil from Fig. 1. Assuming an average heating value of 13,000 Btu per lb, coal costs range from a low of about 15c per million Btu, at the mines, to somewhat more than 30c in locations where long rail hauls are necessary. Diesel oil remained at about 5c per gallon during the war, but it has increased in price during the past year until its cost is between 60c and 80c per million Btu.

Since May of 1945, the Locomotive Development Committee of Bituminous Coal Research, Inc., has been engaged in a program of applied research leading towards the building of two large gas turbine locomotives. The Committee is composed of the chief executives of nine major coal-carrying railroads and four leading coal producers, headed by Mr. Roy B. White, President of the Baltimore and Ohio Railroad. A study of the successful operation of the Brown Boveri oil-burning gas turbine locomotive showed that it had successfully met the major requirements of railroad service, while consideration of railroad fuel costs—about 15c per million Btu for coal as contrasted with 50c to 70c per million Btu for oil—indicated that major economies could be effected in locomotive operating cost if coal could be used in the gas turbine power plant.

Aside from the obvious difficulties of coal preparation in the restricted space available on a locomotive, the major problems to be solved were the burning of coal under pressures up to 75 psia at heat release rates of 1,000,000 Btu per hr per cu ft, and the removal of a large part of the fly ash from the products of combus-

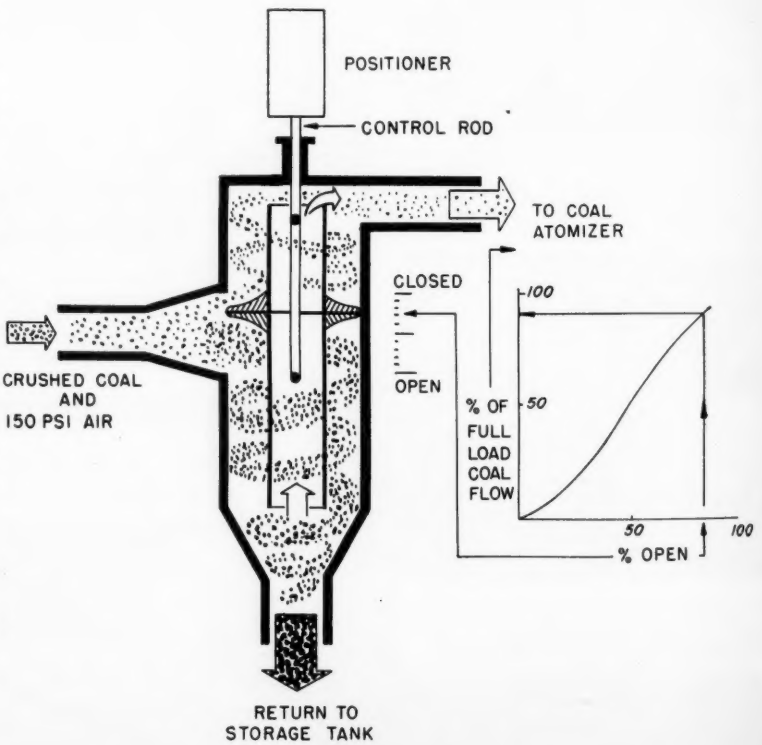


Fig. 6. By-Pass Controller

THE BIRD-ARCHER 8-POINT WATER TREATMENT SERVICE

1. *Study of all available water sources*
2. *Plant Survey, including flow diagram*
3. *Laboratory Service for scientific analysis*
4. *Development of treatment and control equipment*
5. *Instructing plant staff and furnishing test equipment*
6. *Furnishing properly prepared treatment materials*
7. *Installing automatic equipment if necessary*
8. *Periodic check-ups by service engineers*

José's little factory is not plagued with the problems of foaming and corrosion . . . because his power plant consists of his pedal extremities. If power efficiency drops, it's due to bunions rather than boiler scale.

If you use water for boilers, process, or cooling, Bird-Archer can be a real help in keeping operating costs down, efficiency up, and lengthening the life of water and steam handling equipment.

Bird-Archer chemists and engineers are specialists in water conditioning . . . have been for over 60 years. They offer a complete, 8-point service—all or any part of which is available to you.

For a full explanation of how Bird-Archer services can best help you, ask to have a Bird-Archer representative pay you a visit.

LABORATORIES ENGINEERS CHEMISTS

BIRD·ARCHER

THE BIRD-ARCHER COMPANY • 400 Madison Ave., New York 17, N. Y.
Philadelphia, Pennsylvania • Chicago, Illinois • Montreal, Canada

BA-111

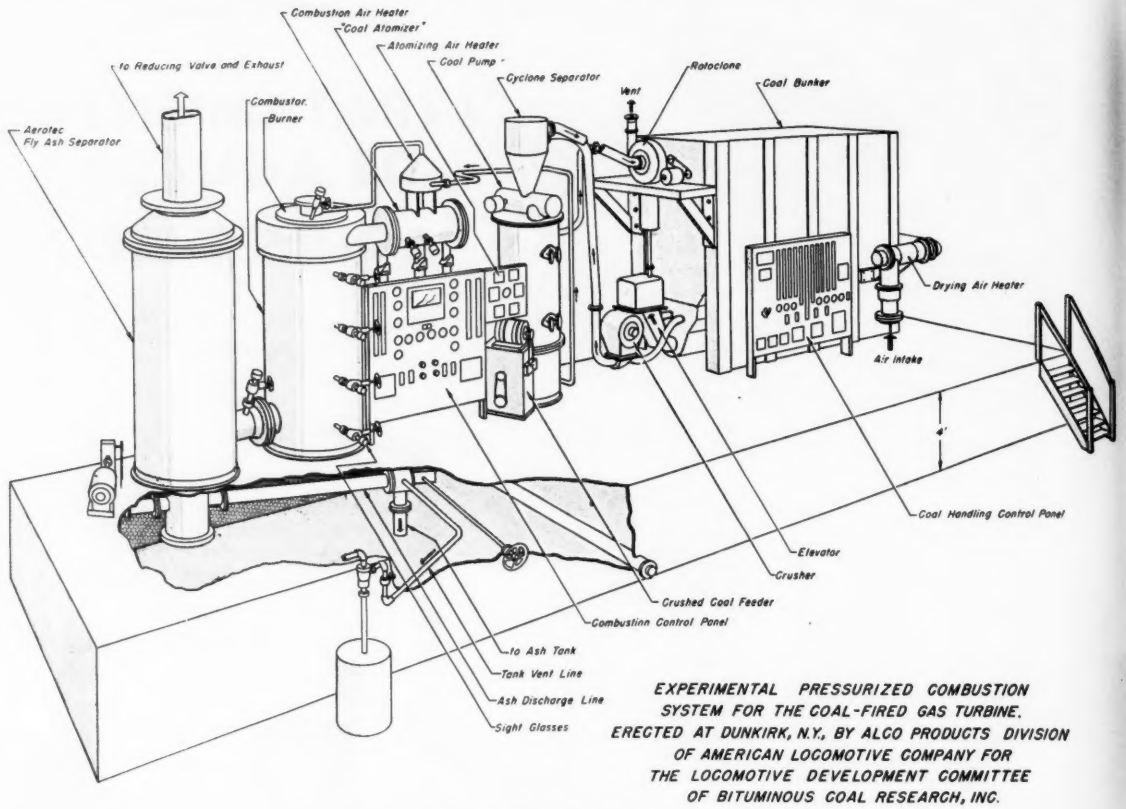


Fig. 7. Dunkirk Pilot Plant

tion. After two years of intensive work at Battelle Institute, Institute of Gas Technology, Johns Hopkins, Purdue, and Southern Research Institute, a coal-handling system has been devised which can take ordinary railroad coal from a locomotive bunker, put it under pressure, feed it in atomized form to an aircraft-type combustor, and eliminate the abrasive components of the fly ash by means of a battery of small separator tubes. Two large gas turbine power plants are now under construction and locomotives to utilize them are being designed.

The coal-handling system is shown diagrammatically in Fig. 2. This illustration shows the Elliott 3750 hp plant which employs a two-stage centrifugal compressor and a five-stage reaction turbine. The coal, of regular railroad quality and size, is supplied from the bunker by means of an engine-driven stoker. The stoker trough is jacketed, so that hot air from the turbine exhaust can be used to dry the coal before it is raised through the inclined elevator section and delivered over a magnetic pulley to a small hammer mill. The mill crushes the coal to —10 mesh and removes any metallic foreign matter which may have escaped the magnetic separator.

The hammer mill discharges the coal through a screen, which prevents the passage of over-size particles, into the pickup of an air conveyor system. The air lifts the coal to a primary separator, where most of the coal is dropped into the intake of the coal pump. The air then passes through the suction fan and is discharged through a secondary separator which removes all but the slightest traces of coal from the conveying air before it is vented. Figure 3 gives some details of the elevator and crusher arrangement.

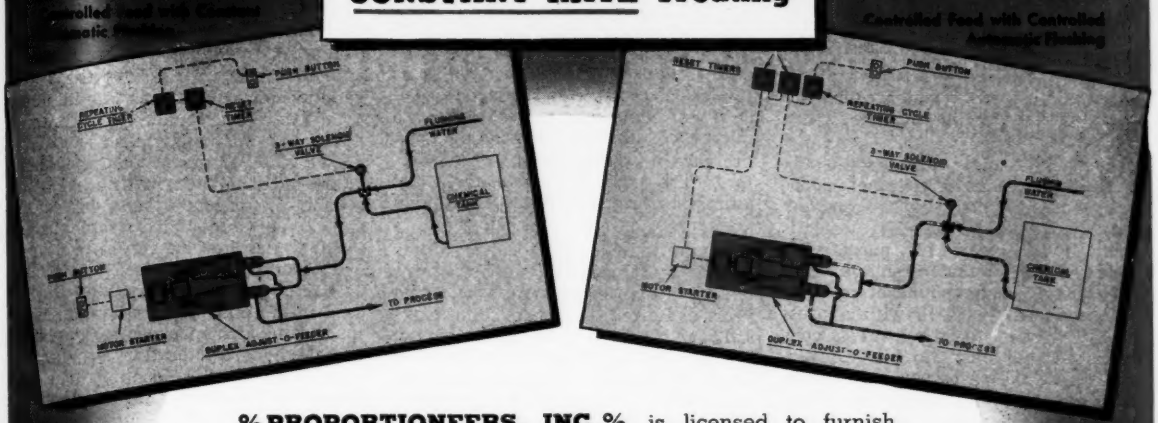
The fuel is pressurized by a slide valve "coal pump," Fig. 4, in which the sequence of events is established by rotating cams driven by a small air motor. The pump can handle from 60 to 100 lb of crushed coal per minute with a 60-second cycle of the timing device. Since the power pistons, the pressurizing and vent valves, and the timing motor are all air-operated, the unit requires no electricity and needs only a very small quantity of compressed air. The pump drops the coal directly into the storage tank where it is kept at 150 psi while the unit is running.

Supplying the coal to the pressurized storage tank is done automatically, using the devices shown in Figs. 3 and 4. The amount of crushed coal in the storage tank is weighed continuously by the pneumatic balance (Thrus-Torq) which transmits to the coal weight recorder and coal supply controller a pressure which is proportional to the weight of the coal in the tank. When the controlled air line pressure, Fig. 5, falls below 20 psig (500 lb of coal in the tank), the coal supply controller opens, admitting air to the pressure switches which start the suction fan, the coal pump, and the crusher. Interlocks are provided, so that the stoker will start only when the conveying air is flowing properly and the crusher is up to speed. Failure of either the crusher or the suction fan will stop the stoker. A time delay is provided to allow the crusher to come up to speed before the stoker is started. The development of a flexible-bottom tank and the pneumatic balance allows positive control to be exercised over the coal supply system. When the crushed coal tank is filled, the coal supply controller closes the valve on the line leading to the pressure switches and opens the vent which also allows the stoker to stop and the gate to close before the crusher, suction fan, and coal pump are stopped.

The feeding of coal to the turbine is accomplished by the constant speed screw which is located at the bottom of the crushed coal tank. Air at 150 psi, and at constant velocity, picks up the coal from the discharge of the screw and carries it to the by-pass controller, Fig. 6. Here any desired portion of the coal is separated from the conveying air and returned to the

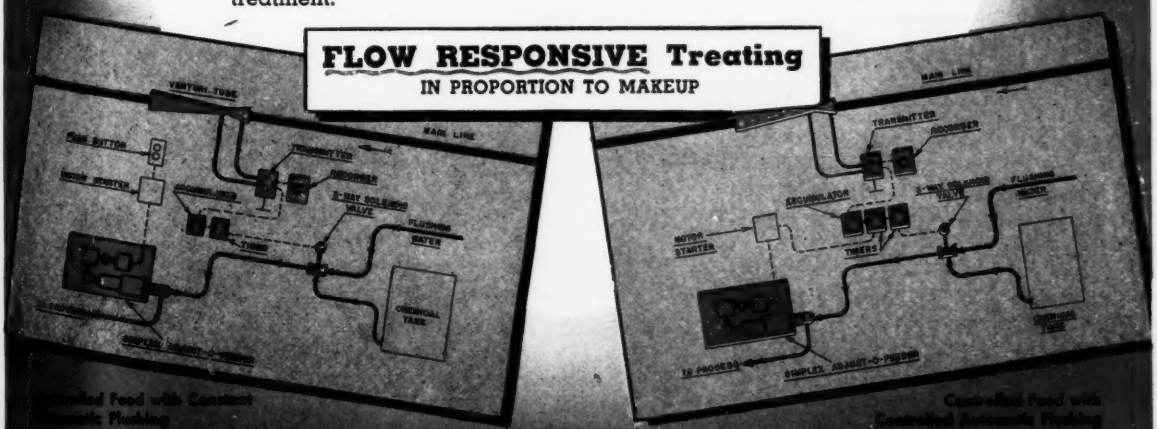
%PROPORTIONEERS% Flexible Control IN BOILER WATER CONDITIONING

CONSTANT RATE Treating



%PROPORTIONEERS, INC.% is licensed to furnish feeding and flushing equipment and can engineer any type of control for applying boiler treatment. Illustrated here are a few of many possibilities demonstrating the use of various controls. Constant rate systems are lower in first cost and will fulfill requirements when the demand is comparatively steady. Where the demand fluctuates, or where a continuously integrated control is desirable, the flow responsive control from a Venturi meter is recommended. %Proportioneers, Inc.% flexible control in boiler water conditioning conserves valuable chemicals, reduces operator time and assures uniform, proper treatment.

FLOW RESPONSIVE Treating
IN PROPORTION TO MAKEUP



Controlled Feed with Constant Automatic Flushing

Controlled Feed with Controlled Automatic Flushing

ASK FOR YOUR COPY! How an industrial power plant solved its boiler problems is described in a timely article just reprinted at our request. You'll find it valuable reading . . . . write for Reprint TR-5oday!

% PROPORTIONEERS, INC. %

WRITE TO %PROPORTIONEERS, INC.%, 46 CODDING STREET, PROVIDENCE 1, RHODE ISLAND
Technical service representatives in principal cities of the United States, Canada and Mexico.

tank. The remainder of the coal passes on with the total conveying air supply to the coal atomizer and the combustor. The importance of maintaining a constant pressure on the crushed coal storage tank should be emphasized, because varying pressure at this point makes the coal feed erratic.

The by-pass controller, shown in Fig. 6, is a modified or adjustable cyclone separator. Tests at Johns Hopkins University have shown that it can attain an almost linear relation of opening versus coal flow. It will be operated by a power piston which will be controlled by the throttle of the gas turbine.

The coal atomizer has been the subject of continuous development since its invention in 1944, and the most recent version can produce coal which is virtually all below 100 mesh, with about 80% below 325 mesh. Quantity of air required per pound of coal has been reduced to 0.5 lb with a pressure drop of 80 to 90 psi. Tests conducted at the Johns Hopkins University during the past year have established a theory of operation which adequately explains the performance of the nozzle-type pulverizer and enables the user to predict with confidence the product size which will be obtained with varying coal grindability, air pressure and temperature, air-to-coal ratio, etc.

It is desirable to maintain a constant air velocity in the coal pickup line, but changes in turbine load require that the total quantity of air entering the atomizer vary in direct proportion to fuel flow. This is accomplished by maintaining the pickup line flow at the minimum amount and supplying the additional air, needed as load goes up, through a supplementary line. The increased air flow is made possible by adjusting the size of the nozzle throat, again using a power piston which is also controlled from the turbine throttle.

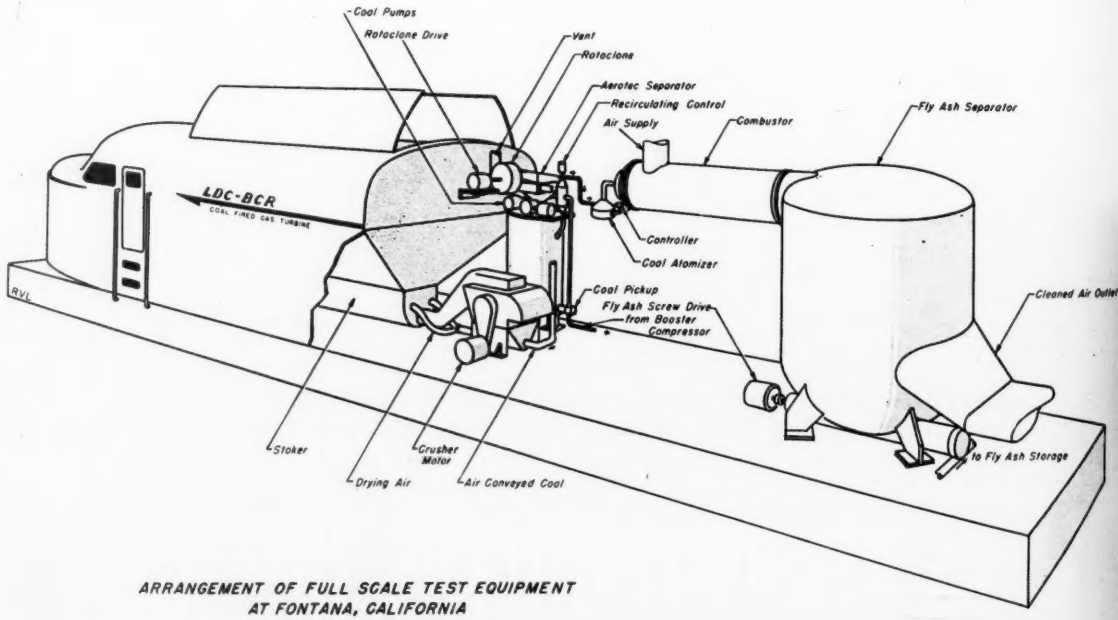
The coal particles which are produced by the atomizer are comparable with the droplets in the mist from an oil atomizer. The smallest sieve which is used in coal size determination has 325 openings per inch, with an average opening size of 42 microns (25,000 microns equal 1 inch). Oil spray droplets range from 10 to 20 microns in diameter, depending upon pressure drop and many other factors. The coal fragments from the atomizer average about 10 microns in diameter on a numerical basis.

Combustion in the coal-fired gas turbine has been the subject of intensive work during the past two years at Battelle Institute, Johns Hopkins, and at the pilot plant of the Locomotive Development Committee which is located in the Dunkirk, New York works of American Locomotive Co. (Alco Products Division). The combustion research was hindered in the early stages by coal feeding difficulties, but these were eventually overcome and consistent data were obtained. The results may be summarized by saying that a heat release of 1,000,000 Btu per hour per cu ft of combustion volume can be attained without difficulty. In the first zone of extremely intense burning just beyond the burner tip, where most of the volatile matter is consumed, the heat release may be as high as 4,000,000. In the later stages, where the remaining coke is being consumed, the heat release is considerably lower.

Ignition of the coal is effected by the use of a small pilot flame of oil or gas, which is in turn lit off by a spark. As soon as the coal flame is established, the ignition system can be turned off. It is anticipated that an oil burner will be incorporated into coal-fired combustors for stand-by and warm-up service; starting and stopping will be done with oil, while coal will carry the operating loads.

The combustor will have the usual gas turbine arangement of an internal flame tube, surrounded by an annular space through which the cooling air flows. The type of perforated tube developed for jet engine use has been found to give good results with coal, and to possess very desirable flame stability despite changes in pressure, air velocity, and coal feed rate. It is probable that two combustors will be used in parallel, in order to conserve space, and also in order to keep the flame tube diameter down as far as possible to facilitate cooling. The intense radiation from the coal flame makes cooling difficult, and particular care must be used in locating the air admission holes.

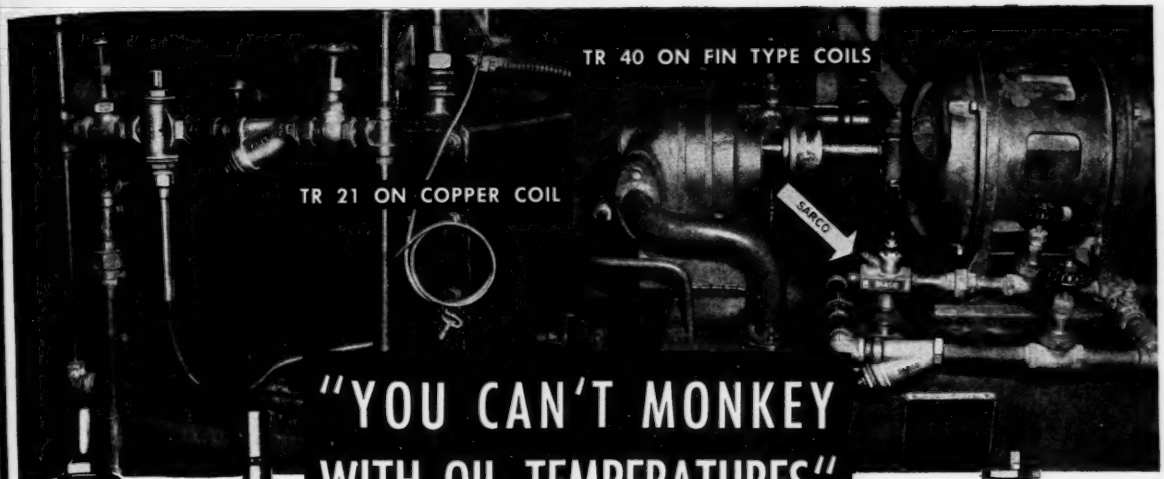
Velocities in the flame tubes are selected to give between 0.1 and 0.2 seconds of holding time for the coal particles. It has been found that pressure has very little effect on the rate of burning of pulverized coal. The original information obtained at atmospheric pressure by R. A. Sherman at Battelle has correlated well with the data from the pressure tests. Combustion of the very last trace of car-



ARRANGEMENT OF FULL SCALE TEST EQUIPMENT AT FONTANA, CALIFORNIA

LOCOMOTIVE DEVELOPMENT COMMITTEE and NORTHROP-HENDY COMPANY

Fig. 8. Fontana Plant



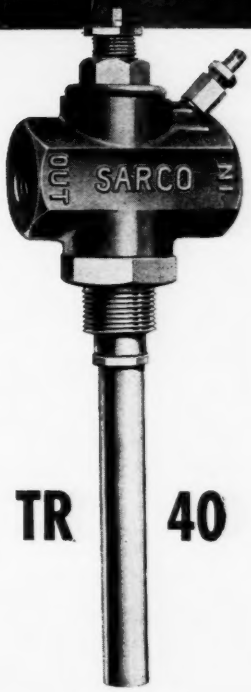
"YOU CAN'T MONKEY WITH OIL TEMPERATURES"

That was the comment of the mechanical engineer who settled the question by installing two different types of Sarco Regulators to control the oil cooling systems for a battery of 280 ton hydraulic extruding presses.

With incoming lake water varying in temperature all the way from near freezing up to 120 degrees because of the heat in the balcony, the oil has been going down to the presses at close to 100 degrees for more than three years. Metered water used was cut 50% and the controls have paid for themselves many times over.

This is typical Sarco Service which includes many types of steam traps and temperature controls. The Sarco Representative near you can help to solve your problems at lowest cost and with permanent satisfaction.

TR 21

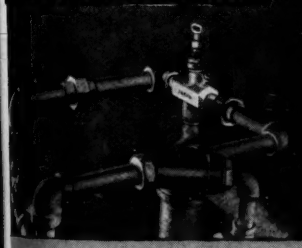


TR 40

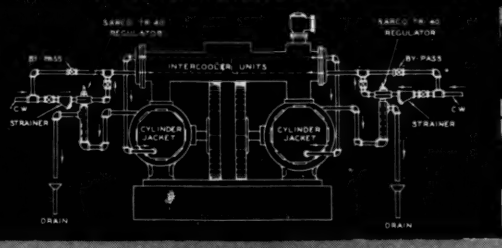
OTHER WAYS TO SAVE WITH SARCO CONTROLS

157

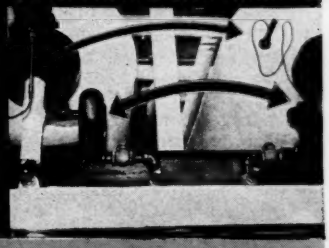
TR 40 ON CONDENSER



TR-40 ON COMPRESSOR



TR 21 ON HOT WATER TANKS



SARCO SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

bon in the fuel is not practical, because it would require excessively long flame tubes. A tube 6 ft long with a 30 ft per second average air velocity can provide enough holding time to burn out some 96 to 97% of the fixed carbon.

Fly Ash Separation

The fly ash which always remains when powdered coal is burned must be removed before the heated air can enter the turbine. Ordinary fly ash carried in high-velocity air streams is very abrasive, and it would damage turbine blades in a short time. However, tests carried out for the Locomotive Development Committee at the Institute of Gas Technology in Chicago have shown that, if the particles larger than 10 microns are removed, the heated air is no longer abrasive. Because of the very large amount of excess air which is available for cooling, molten ash particles are frozen before they leave the flame tube, and slag is not encountered. The fly ash particles may be much larger than the coal particles, however, as a result of the agglomeration which takes place in the flame.

The removal of small particles from gas streams by mechanical separators requires the use of small tubes. The laws of cyclone performance are reasonably well understood, and several very effective types are now available. The ash removal work for the Locomotive Development Committee has been concentrated on the Aerotec tube, which was developed during the war from the well-known Prat-Daniel collector. Extensive tests have shown that virtually all particles larger than ten microns can be removed by these small separators, together with a surprising amount of the finer dust. It is to be expected that cyclone collection efficiency would fall off at higher temperatures, because of the viscosity of the air, and this proves to be true. By increasing the air velocity, however, this decrease can be overcome and at the same time there is a reduction in the number of tubes needed for a given air quantity. The pressure loss in the tube varies as the square of the air velocity, which means that care must be used to prevent the selection of a pressure drop high enough to affect the cycle adversely.

The capacity of a single three-inch diameter tube is obviously small, and so a large number of them must be used in parallel. For example, an air flow of 240,000 lbs per hr at 75 psia and 1300 F requires 220 tubes. The most effective arrangement is to mount the tubes horizontally in rings around a central dust-collecting space. The cleaned air is discharged radially outward, and it must be directed by proper guide passages to the outlet duct. By using a number of tube rings in a vertical bank, the tubes needed for a 4000 hp turbine plant can be contained in a 6 ft tank less than 8 ft high. The fly ash is removed from the central space by means of a slowly rotating screw, which carries it to an external ash storage tank.

Pilot Plant Tests

The Dunkirk pilot plant has been in service since January, 1947. All of the components have been subjected to extensive tests, and each has operated in the intended manner. The pressurizing of the coal has been the most difficult problem, and coal pumps of three different types are now being developed. A piston-type pump was used successfully during a 24-hour continuous test run, at a burning rate of 500 lbs of coal per hr, and its capacity has subsequently been increased to more than 1200 lbs per hr. Several such pumps in parallel would supply a gas turbine plant of moderate size. The 24-hour test proved that the entire coal system could be satisfactorily controlled and that constant air temperature could be obtained from a combustor supplied by a screw feeder.

A full-scale working "mock-up" of the entire coal handling, combustion, and fly ash removal system is now being erected at the Fontana, California test site of the Northrop-Hendy Company, located at the Kaiser Steel Mill. 100,000 cfm of air at 50 psia can be obtained from a blast furnace blower, so that full-size combustors can be tested up to their maximum coal firing rate.

The coal-fired gas turbine should become a reality during 1948, when the Elliott Company will deliver a 3750 hp plant and the Allis-Chalmers Co. will supply a 4200 hp unit. Both plants will be installed in locomotive chassis as soon as plant tests are completed.

BIBLIOGRAPHY

(1) "Modern Metallurgy for Engineers," F. T. Sisco, p. 359; Pitman, New York, 1941.
(2) "The Book of Stainless Steels," C. E. MacQuigg; American Society for Metals; Cleveland, 1935.
(3) "Digest of Steels for High-Temperature Service," Fifth Edition, 1946; The Timken Roller Bearing Co., Canton, Ohio.
(4) "Wrought Heat Resisting Alloys for Gas Turbine Service," C. T. Evans, Jr., *Metal Progress*, November, 1945.
(5) "Superalloys for High-Temperature Service in Gas Turbines and Jet Engines," *Metal Progress*, July, 1946.
(6) "Characteristics of Three High-Temperature Alloys," J. B. Henry, Jr., *Iron Age*, June 12, 1947, p. 58.
(7) "The Development of 16-25-6 Alloy," by Martin Fleischmann, *Iron Age*, January 17 and 24, 1946.
(8) "Materials for Power Gas Turbines," C. T. Evans, Jr., ASME Annual Meeting, December 6, 1946.
(9) "Problems in the Mechanical Design of Gas Turbines," R. B. Smith; ASME Transactions, June, 1947; p. A-99.
(10) "Ceramic Coatings for High-Temperature Protection of Steel," by Harrison, Moore, and Richmond; *Journal of Research*, National Bureau of Standards, Vol. 38; March, 1947.

SELECTING AND INSTALLING THERMOCOUPLE LEADWIRES

(Continued from page 112)

ured. The other end of the length of leadwire stock forms the cold junction of the thermocouple and is immersed in an ice water bath. The resultant emf generated by this thermocouple is measured by an accurate potentiometer and the indication compared with a standard value for the type of leadwire under test. If the emf of the leadwire under test is within permissible tolerances, it is accepted.

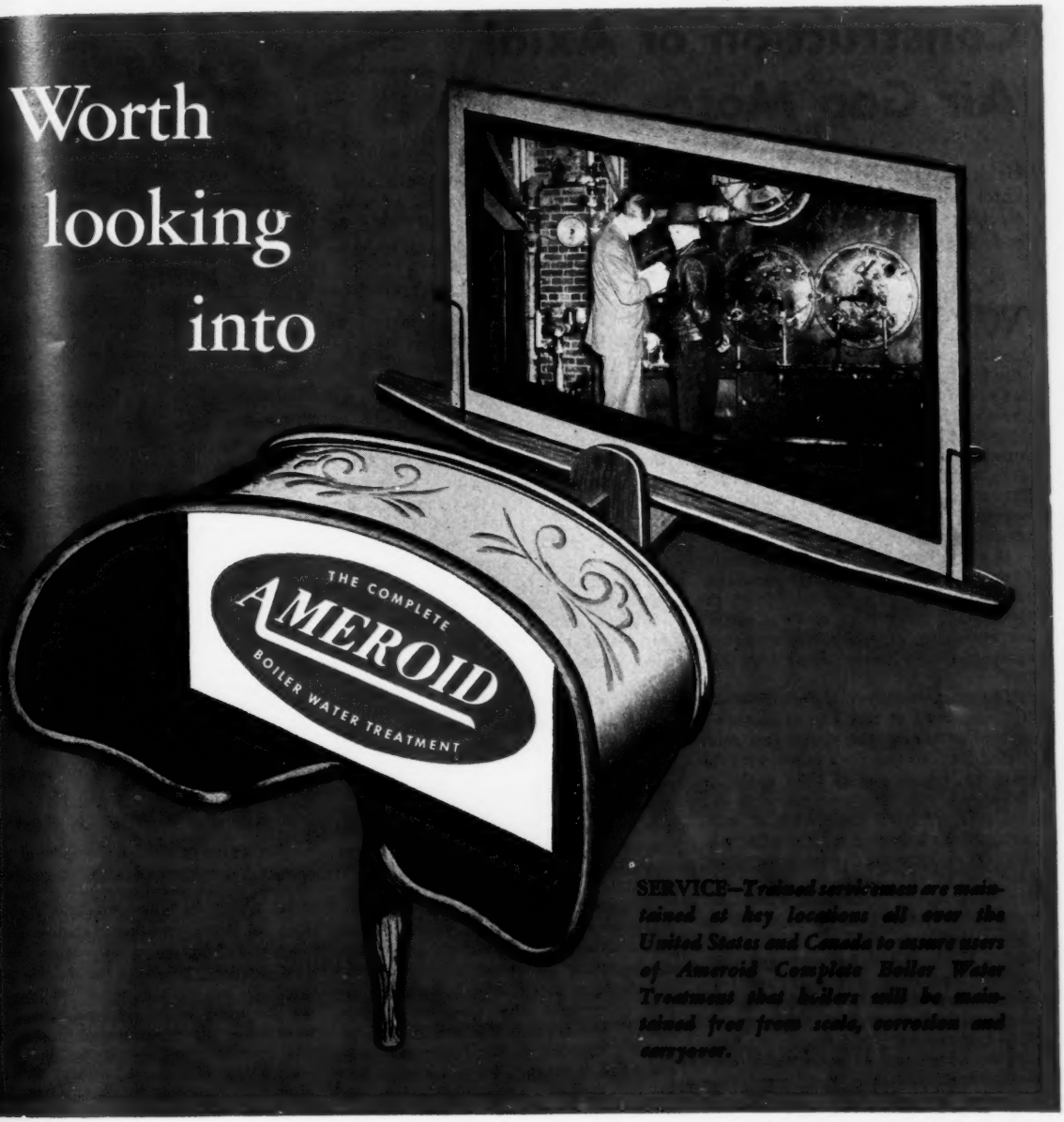
In addition to the thermoelectric tests made on the leadwire, the dielectric strength of the insulation is tested. By the use of an ohmmeter, the leakage resistance between the two conductors of the extension leadwire cable under open circuited conditions is measured. Inasmuch as this leakage must be held to a certain limit, only such leadwire whose leakage measurement is not lower than the specified value is acceptable for use. Because of the fact that moisture may be a serious cause of insulation leakage, certain kinds of insulation are tested after the leadwire has been immersed in water for seven days. At the expiration of this period, the leakage resistance between each conductor and the water is measured by connecting one lead from the ohmmeter alternately to each conductor, while the other ohmmeter lead is immersed in the water. At this time an insulation breakdown test is also made by connecting a high alternating voltage across each conductor and the water.

Installation of Leadwire

The proper installation of the extension leadwires is of no less importance than the wire itself in the attainment of accurate pyrometer readings over long periods of service. Many failures and inaccuracies in pyrometer systems have been the result of poor electrical connections and grounded wiring.

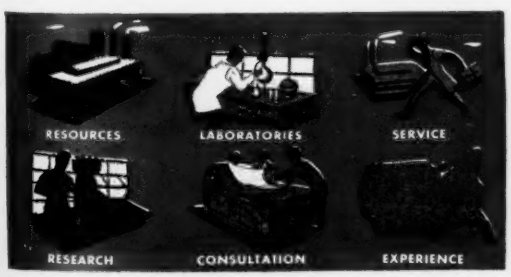
There are but a few rules to be followed in making a proper installation. Whenever possible, the leadwires should be run in conduit to protect them against the possibility of mechanical injury. All necessary *splices* must be *soldered wrapped first with rubber tape* and *then with friction tape.* It is extremely important that the polarity markings throughout the wiring between thermocouple and the indicating instrument be followed and that they be connected in the proper polarity at all terminals. For example: The red negative lead, common to most extension leadwires, must first be connected to the negative terminal on the thermocouple; the red colored conductor must then be spliced only to a red colored conductor throughout the wiring to the instrument at which point it must be connected to the negative terminal of the indicating instrument. The observance of these simple rules for the wiring of the pyrometer system not only assures accurate results, but dependable service.

Worth looking into



SERVICE—Trained servicemen are maintained at key locations all over the United States and Canada to assure users of Ameroid Complete Boiler Water Treatment that boilers will be maintained free from scale, corrosion and carryover.

When you look into the AMEROID system you'll find it backed by all the factors necessary for a completely successful boiler water treatment . . . a national service organization of trained chemists and engineers; modern analytical laboratories; controlled manufacturing facilities; a progressive research program; and the "know how" that comes only from wide experience. An AMEROID representative will be happy to discuss boiler water conditioning with you at your convenience.



E. F. DREW & CO., INC.
15 EAST 26th STREET, NEW YORK 10, N. Y.
COMPLETE AMEROID SERVICE is available in key cities of the United States, Canada, Mexico, Brazil and Puerto Rico.

Construction of Axial Air Gap Motor

Fields of rotor and stator made in disc form of punched strip magnetic steel. Rotor winding is of centrifugally cast copper, stator winding is of wire, machine wound directly in slots. Roller bearings are employed. Weight and size are minimum for rated capacity. Cool running characteristics

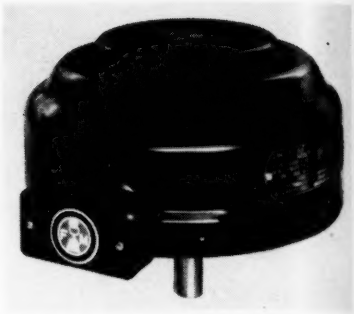


Fig. 2. Vertical axial air gap motor

WHAT has been proclaimed as an entirely new commercial type of electric motor has recently been put into full production by Fairbanks, Morse & Co. of Chicago. The motor has passed the experimental stage with more than 20,000 of them now serving industry, but announcement to the public has been withheld until the new factory at Freeport, Illinois, was sufficiently equipped to carry on assembly line production.

In sizes from ⅓ to 10 hp suitable for horizontal or vertical flange mounting, or on an angle base for belt drive, the outstanding advantages of these motors are reduction of space and weight as compared with conventional type motors.

The main fundamental feature of design employed in this line of motors—that of arranging the stator and rotor in disc form to face each other, with the plane of the air gap at right angles to the axis of the shaft—is not new, for this principle was discovered in early research work dealing with electric motors. Due, however, to manufacturing practices of that time, the motor was developed along cylindrical form of stator and rotor which has come to be the conventional type of today. Fairbanks, Morse & Co., however, put their research and development engineers to work to create a new design using the disc principle and adaptable to assembly line manufacture which would have definite advantages in some fields over conventional motors of small size. This objective has now been accomplished and a new factory plant is in full capacity production.

One of the most difficult problems to solve in the manufacture of these motors, that work on the induction principle and are suitable for adaptation to single, two-phase or there-phase operation, was the method of forming the discs and the punching of the slots for the stator and rotor windings. Coiling strip steel into shape of a thick disc and then forming slots by machining or broaching is laborious and uneconomical. To make it practical, apparatus had to be developed that would punch the slots and coil and form the disc. Uniform spacing of the slots in the strip steel sheets is not possible because the slots would not line up when coiled.

Controlling the slot spacing uniform by coiling and punching simultaneously is also not practical. This results in the slots lining up in an Archimedes spiral and as such it would be impossible to insert the stator windings. The machinery designed and developed not only punches and coils the strip, but also transforms the line up of slots from an Archimedes spiral to a straight line. The successful development of apparatus to accomplish this has made the manufacture of the axial air gap motor commercially practical.

In solving assembly problems and air gap tolerances, the so-called "inside frame" was developed in which the supporting member of the stator also supports the bearings. This is accomplished by a hollow cylindrical extension through the center of the coils, this extension being an integral part of the frame. The inner race of the rotor and bearing is stationary. The stator end bearing is conventionally mounted, fixed in position and is a double row type to take care of the magnetic thrust between the stator and rotor.

The inside frame construction results in a material reduction in weight and size of the motor. It eliminates air gap inaccuracies that occur if separate members were required for the support of the bearings and it permits the length of the gap to be controlled by the axial measurement of three dimensions, the shaft length and rotor and stator facing dimensions.

The axial air gap motor, with a rotor diameter equal to that of the stator core, requires a rotor of greater mechanical strength than that used in conventional designs. The one piece centrifugally cast "copperspun" rotor provides this added strength with an adequate margin of safety.

Features of Axial Air Gap Motors

Reduction in size of the axial air gap motor as compared with conventional motors is the most outstanding feature. The length is approximately one-half that of the conventional motor with a diameter from one to two inches larger.

Reduction in weight is another feature. In general this reduction averages on the order of 30 per cent. The large area of corner waste in the punching of the conventional motor lamination is completely eliminated. About the only waste of core steel in the axial air gap motor is the material that is punched out to form the stator and rotor slots.

The axial air gap motor is easy to cool and ventilate. The rotor diameter is large, fans are cast integral with the spider and most of the coil extensions

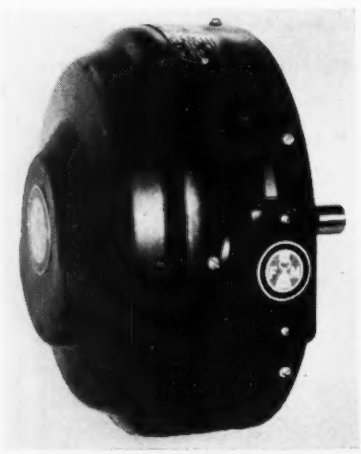


Fig. 1. Horizontal axial air gap motor

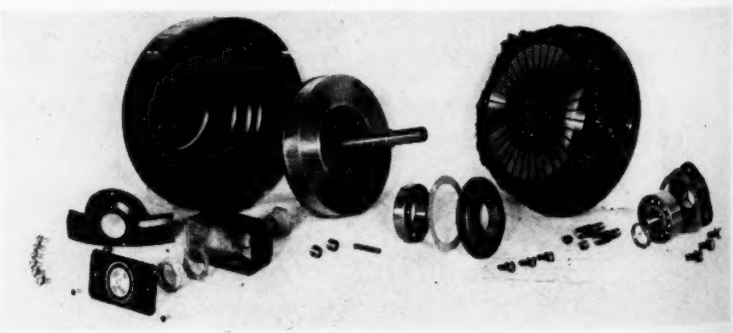
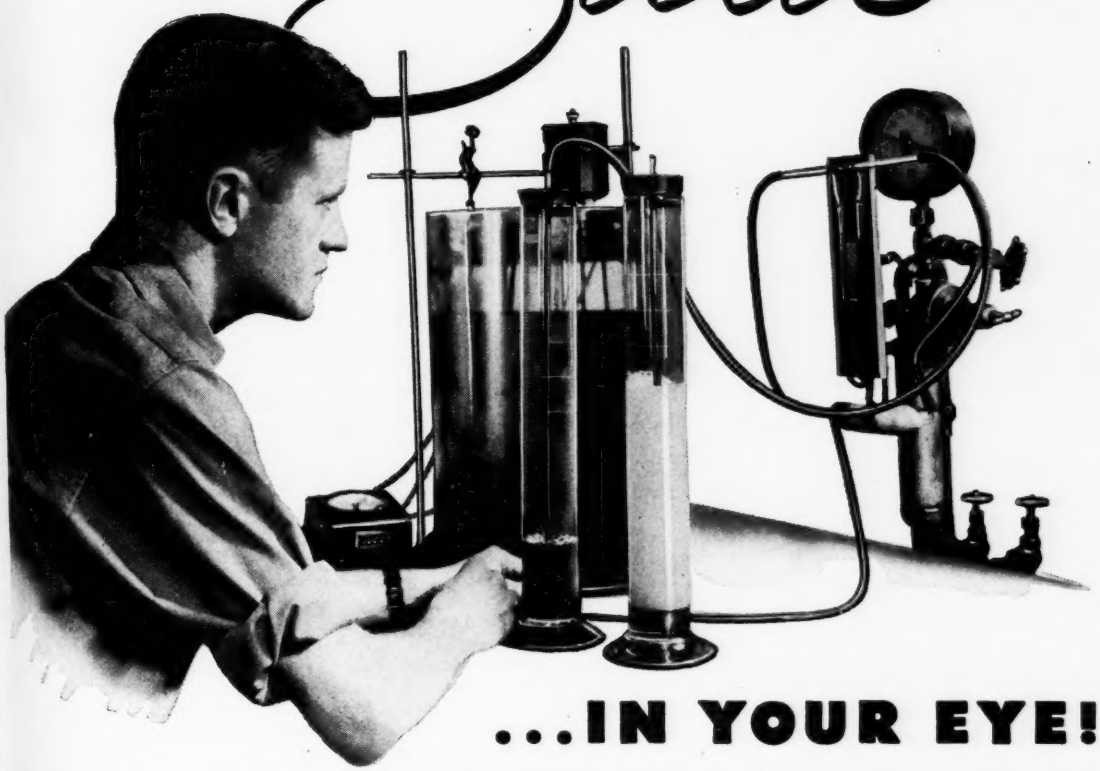


Fig. 3. Parts of new type motor disassembled

HERE'S *Suds*



...IN YOUR EYE!

The suds very much in your eye as you look at the photograph above is lubricating oil which foams badly and, if used in valuable equipment, constitutes a hazard to positive lubrication, which can increase maintenance costs.

At Sinclair Laboratories, skilled technicians, like the one shown above, study and test lubricating oils constantly for foaming characteristics. Through research in the study of additives, Sinclair provides anti-foam characteristics and assures positive lubricating film plus maximum heat dissipation for protection against wear and failure.

Through such painstaking research, Sinclair maintains production of lubricants of consistent high quality. Sinclair Laboratories and outstanding research are behind the dependable performance of all Sinclair Lubricants for Industry.

Sinclair Lubricants for the Power Plant

For Turbines:
SINTURLITE OILS

For Steam Cylinders:
SINCLAIR STEAM CYLINDER AND VALVE OILS

For Compressors:
RUBILENE OILS

For Ball and Roller Bearings:
BEARING GREASE AF

SINCLAIR REFINING COMPANY • 630 FIFTH AVENUE, NEW YORK 20, N. Y.

SINCLAIR

Lubricants for Industry

FINEST CRUDES + EXPERT RESEARCH and MANUFACTURING CONTROL = OUTSTANDING PERFORMANCE

Fig. 4. Assembly line where operators work stator winding and inserting machine

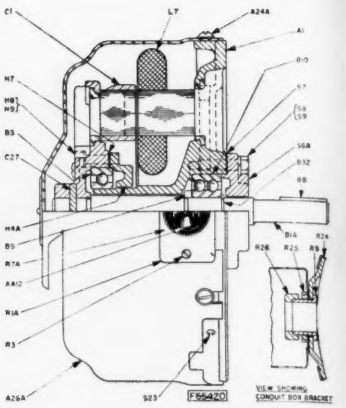


Fig. 7. Cross-section of new type motor indicating locations of parts

A1 — Stator Frame. AA12 — Trademark Plate. A24A—Conduit Bracket, Cover Screws, Lockwashers. A26A—Sheet Metal Cover. B1A—Shaft. B3—Rotor or Free End Bearing. B8—Pulley Key. B9—Shaft Collar. B10—Stator or Drive End Bearing. B32—Tru-arc Ring. C1—Rotor Assembly. C27—Rotor Pin. H4A—Rotor Bearing Closure. H7—Gasket. H8—Capscrews. H9—Lockwashers. L7—Stator Coils. R1A—Conduit Box. R3—Conduit Box Cover Screws. R7A—Conduit Box Cover. R24—Conduit Box Bracket. R9—Chase Nipple. R25—Locknut. R26—Bushing. S6A—Stator Bearing Closure. S7—Gasket. S8—Capscrews. S9—Lockwashers. S23—Lubrication Plugs.

are on the outside where a large volume of air flows over them.

Primarily a flange mounted machine suitable for either horizontal or vertical operation, the axial air gap motor is the same whether used horizontally or vertically. Only the cover is changed. As a flange mounted motor it has little overhang. The frame and bearing supports are of one piece with the result that the accuracy of the flange such as face runout, concentricity of diameter, shaft runout, etc., can be held to close limits. This is particularly important in gear motors and other direct applications where accuracy is essential.

For chain, belt, or V-Belt drives, belt adjustment is accomplished by use of a pivot base having a three point suspension. Belt tension is adjusted by pivoting the motor about the top supporting screw.

The flywheel effect of the axial air gap motor is approximately three times that of corresponding conventional motors. This is of particular advantage in such applications as punch presses, oil well pumping units, etc., where the added flywheel effect reduces the amplitude of the peak electrical load on the motor. It is, of course, a decided disadvantage on applications involving repeated plugging and reversing where small diameter rotors are essential. The axial air gap motor should not be used on applications of the latter type.

There is a magnetic pull between the rotor and stator of the axial air gap motor which is taken care of by a double row fixed thrust bearing in the stator end of the motor. The rotating magnetic field produced by a distributed polyphase winding has essentially a sinusoidal space distribution. The flux density in the gap can be accurately calculated from winding data and core dimensions.

Speed-Torque characteristics and operating performance is comparable in practically all respects with conventional motors. There is a slight gain in torque output with a given amount of active material due to the radius of gyration being slightly larger than the average radius, but this is of no particular significance. Starting, accelerating, and maximum torques are comparable in all respects since these are determined by design factors that can be incorporated in either type of design. Efficiencies are likewise comparable except that friction and windage losses may be slightly higher with the larger rotor and one thrust bearing. Power factors are dependent on the length of air gap. In general, the air gap of the axial gap motor is a few thousandths of an inch greater to provide smoother starting, maximum efficiency and a more liberal manufacturing tolerance. It is interesting to note that tests conducted on motors with varying air gap definitely prove that stray load losses are increased as the air gap is reduced.

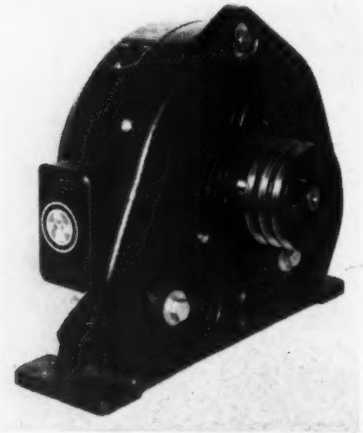


Fig. 5. Axial air gap motor with pivot base

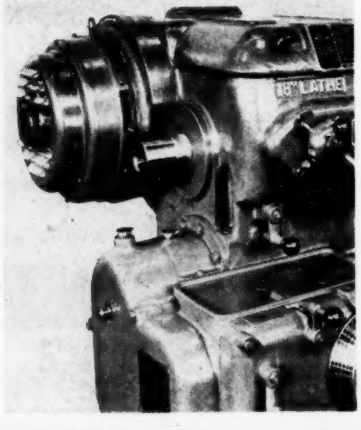


Fig. 6. Axial air gap 10 hp motor applied to machine lathe

Application

The manufacturer states that the axial air gap motor is not intended to supersede or displace the conventional motor in general industrial applications except in those cases where it results in a definite advantage to do so. There are many cases of motor applications, however, where the size and shape of the conventional motor is a decided handicap. The axial air gap motor makes a better flange mounted motor, with reduced overhang, and a more accurate mounting. It is well suited to gear motors where the motor is mounted as an integral part of the unit. It is especially adapted for vertical applications where height is important. In general, it offers to American industry a new and novel style of motor that will assist in expanding and enlarging the manufacture and use of motorized apparatus.

which pump?

When you buy a pump you naturally expect good service, dependable operation, low power and maintenance costs and other benefits. The question is—which pump will give you these benefits in greater measure?

To help you answer this question read the clear statements about our Company and our products—draw your own conclusions.

1. Warren is backed by 50 years experience in building pumps.

2. Warren builds pumps *exclusively*. Our reputation is based *entirely* upon our ability to build pumps.

3. Warren builds practically *all types* of centrifugal and reciprocating pumps and will engineer special pumps for special purposes.

4. Warren ranks well among pump builders as to size, organization and facilities.

5. Warren bows to no one in selecting the right pump for the job. "A Warren recommendation is never a compromise."

6. Our customers include many of the famous names throughout industry.

7. Warren pumps are fairly priced—but not built to a price. Initial cost is insignificant when measured against results.

8. Warren pumps are guaranteed—not only as to quality and workmanship, but also for performance as rated when shipped. Maintained efficiency is inherent in every Warren design.

Why not put your pump problems up to Warren?

Our 50th Anniversary

WARREN PUMPS

Reciprocating and Centrifugal

WARREN STEAM PUMP CO., INC., WARREN, MASS.

Atlanta Boston Chicago Cleveland Denver Detroit Houston Manchester Los Angeles Minneapolis New Orleans New York Philadelphia Pittsburgh Richmond San Francisco Seattle St. Louis

P-8

Diesel Engineering Instructors Take "Refresher Course"

ON SATURDAY evening, June 28, in Chicago, instructors in mechanical engineering from all parts of the country packed their bags and began their return trips homeward, after having taken a practical, intensive "refresher course" in engineering which was without precedent in the Diesel engine industry.

In six days of carefully planned activities, the professors had toured through three Diesel engine factories and two of the country's top-ranking engineering schools, taking a whole day for each of the five visitations.

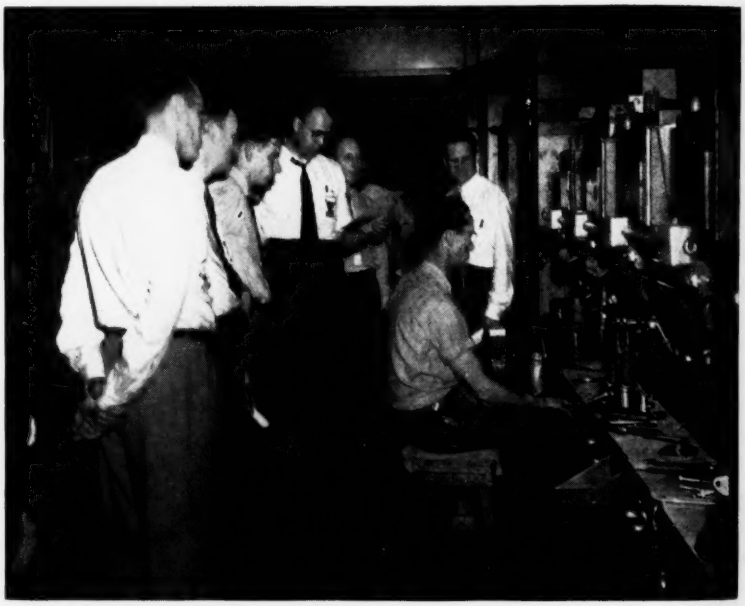
During their inspection of the schools—the Illinois Institute of Technology, and Northwestern University's Technological Institute—the instructors were escorted through the institutions' mechanical engineering laboratories, where they saw equipment which for completeness and modern design is matched in few schools of the country. They witnessed laboratory demonstrations and heard lectures on a wide range of Diesel topics, delivered by the schools' teaching staffs.

At Electro-Motive Division of General Motors Corp., La Grange, Ill.; at the Industrial Power Division of International Harvester Co., Melrose Park, Ill., and at the Beloit, Wis., factory of Fairbanks, Morse & Co., the instructors saw Diesel engines in a wide variety of applications, being manufactured step by step. Design, engineering, research, development, machining, assembling, testing — all phases in which instructors in mechanical engineering are interested — were shown and explained to them by factory guides.

At each school and factory, the personnel there acted as hosts for the day, providing special bus transportation where it was needed, serving lunch, and organizing the instructors into small groups for inspection tours. Each school and factory had set up its own program, with the six-day educational conference as a whole being sponsored by the Diesel Engine Manufacturers Association.

Data compiled when the conference was over showed that 59 instructors from 47 schools had attended the conference. By the time they had returned to their homes they had traveled in the aggregate more than 100,000 miles.

And the results? It can be said for a certainty that the instructors returned to their classrooms much better prepared to teach Diesel engineering than before. First-hand, close-up inspection of modern manufacturing processes, accompanied by expert explanation from factory personnel; insight into research, experiment and development carried on by the three factories and two schools; lectures on many phases of Diesel engineering by factory and school personnel; opportunity to ask questions at every turn and get clear answers; meeting fellow educators and comparing experiences; taking home packets of factory literature describing what had been seen and heard — it all added up to what one instructor said was "worth a year spent in any engineering school in the country."



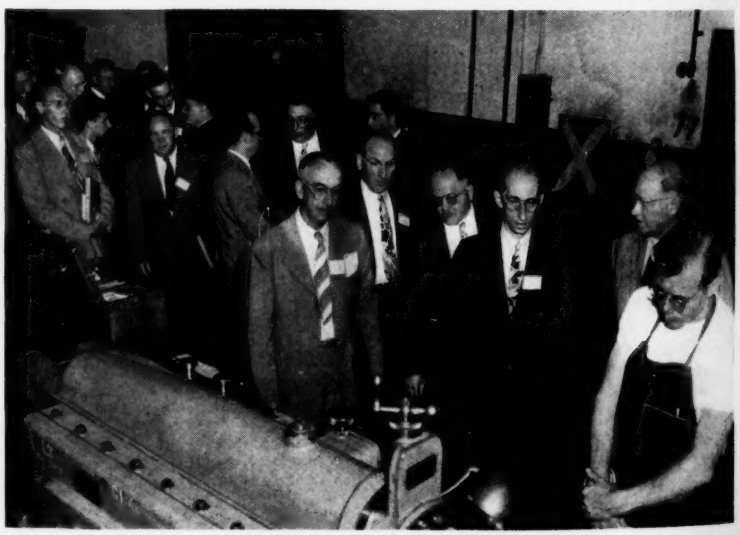
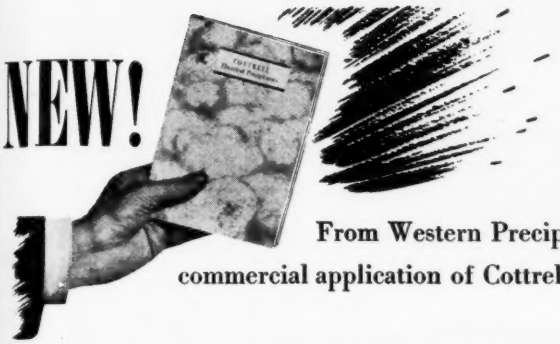


Fig. 1. Top. Calibration of injection pump of Fairbanks, Morse opposed piston engine is viewed by (left to right) Lloyd W. Blanchard, Alabama School of Trades; Maurice E. Weschler, Catholic University of America; Robert J. Jackson, Polytechnic Institute of Brooklyn; L. L. Otto, Cornell University; C. C. McCarthy, Chicago Vocational School, and Fairbanks, Morse representative. Fig. 2, Professors are escorted through International Harvester's engineering shop at Melrose Park. In foreground, left to right, L. A. Wilson, University of Wisconsin; H. J. Kicherer, manager, industrial power engineering shops for International; J. E. Schoen, Marquette University; O. C. Cromer, Purdue University, and Harvey T. Hill, executive director, Diesel Engine Manufacturers Association

XUM

NEW!



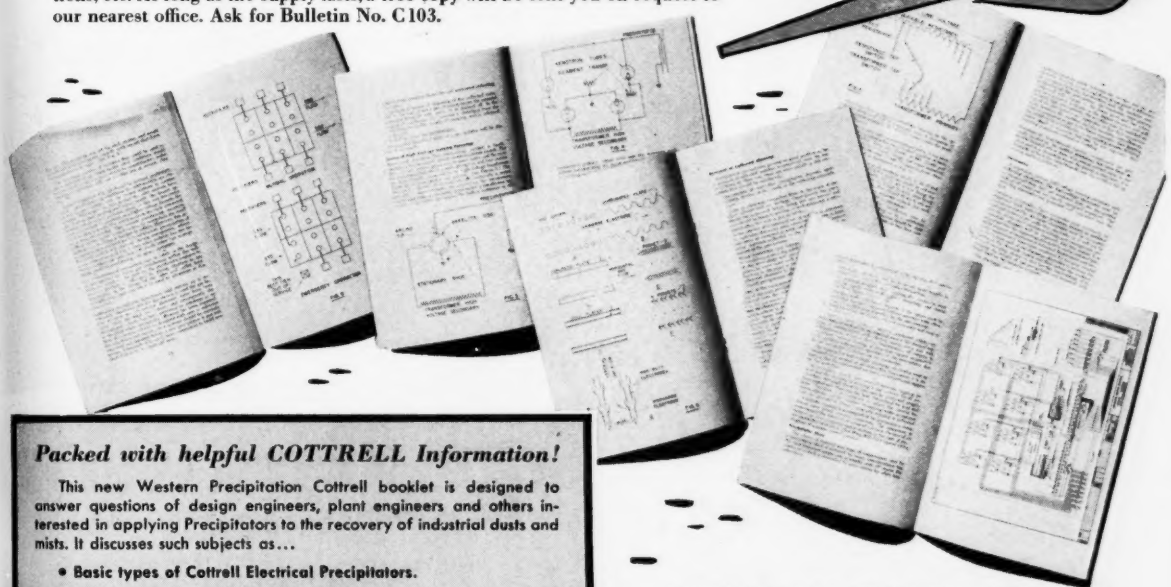
From Western Precipitation—the organization that pioneered the commercial application of Cottrell Precipitation...

IF YOU ARE ENGAGED in any phase of industry where the recovery of dusts, fumes, fly ash, mists, fogs or other suspensions from gases is a problem, you will find this new booklet on the COTTRELL Electrical Precipitator helpful and informative.

Western Precipitation pioneered and installed the first commercial application of the well-known COTTRELL Electric Precipitator—Dr. Cottrell, the inventor, being a member of the company. And for more than 38 years Western Precipitation has consistently led in developing new COTTRELL advancements and techniques for recovering suspensions from gases, both wet and dry.

This new 28 page booklet summarizes many of the basic facts you should know about modern COTTRELL Precipitators—the various types available, how they operate, principal types of electrode systems and rectifiers, shell constructions, etc. As long as the supply lasts, a free copy will be sent you on request to our nearest office. Ask for Bulletin No. C103.

28 PAGES
of helpful facts to know about
COTTRELL ELECTRICAL PRECIPITATORS



Packed with helpful COTTRELL Information!

This new Western Precipitation Cottrell booklet is designed to answer questions of design engineers, plant engineers and others interested in applying Precipitators to the recovery of industrial dusts and mists. It discusses such subjects as...

- **Basic types of Cottrell Electrical Precipitators.**
- **Principal parts of a Cottrell Precipitator.**
- **Mechanical and Electronic Rectifiers.**
- **Various types of Collecting Electrodes (rod curtains, corrugated plates, dual plates, pocket electrodes, etc.).**
- **Removal of Collected Material.**
- **Factors in Shell Construction (steel, concrete, brick, etc.).**
- **Operating Efficiencies and the Effect of Various Factors on Performance.**

...and many other basic Cottrell facts. Write for your free copy of Bulletin C103 today while supplies are adequate!

Western Precipitation is not affiliated with any other company in the field of electrical precipitation except its wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. Whether you are now contemplating the installation of a Cottrell Electrical Precipitator, or may be interested in such an installation at a future date, we can and will serve you in any part of the United States or other countries.

NOW SELLING...

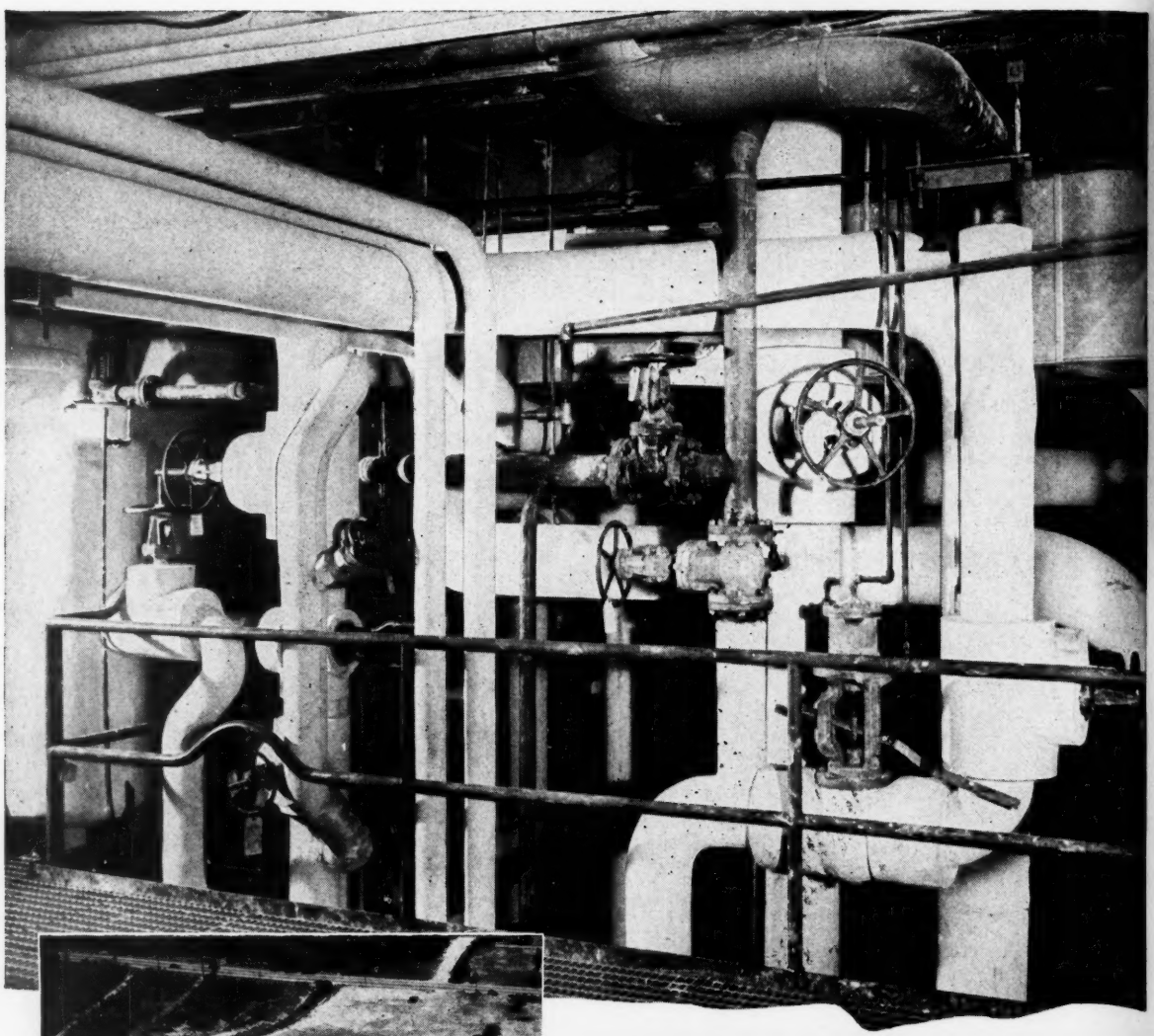
COTTRELL Precipitators
MULTICLONE Collectors
TURBULAIRE Spray Dryers

...in all parts of the U. S. A. and foreign countries.

WESTERN
Precipitation
CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1029 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
CHRYSLER BLDG., NEW YORK 17 • 1 LaSALLE ST. BLDG., 1 N. La SALLE ST., CHICAGO 2 • HOBART BUILDING, SAN FRANCISCO 4, CALIFORNIA
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL



WITH NAVCO PIPING *Results* ARE PRE-ASSURED

Navco's high degree of engineering skill and use of the most modern plant and field facilities are your guarantee of a long lasting and trouble-free piping system.

Consult Navco for Your Next Piping Job.

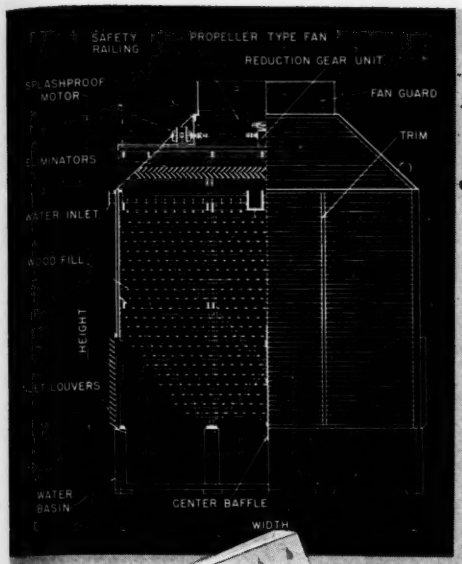
NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

XUM

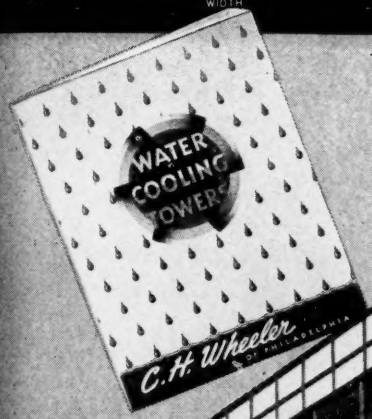


Guaranteed to Withstand Winds of 100 Miles Per Hour

(75 m. p. h. is Hurricane Velocity)

The United States Weather Bureau tells us that "except in connection with tornadoes and tropical hurricanes, wind velocities in excess of 100 miles per hour are relatively infrequent in the United States". C. H. Wheeler Water Cooling Towers are guaranteed to withstand winds of this velocity, thus their efficient design is of lasting satisfaction. Evaporation and drift losses are minimum. Required water cooling is guaranteed. Send for Catalog No. 145 which describes our complete line of towers with housings of redwood, steel, masonry or transite.

C. H. WHEELER MFG. CO.
1802 Sedgley Ave., Phila. 32, Pa.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

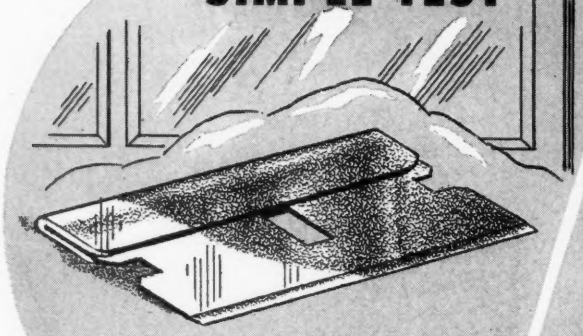


C.H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS · AIR EJECTORS
COOLING TOWERS · HEAT EXCHANGERS

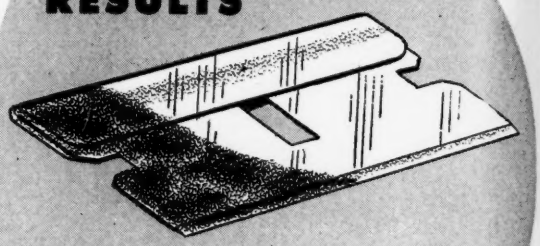
How to PREVENT Corrosion

MAKE THIS SIMPLE TEST



Coat a section of an old razor blade or any piece of raw metal with a protective film of Anti-Corrode. Place it out-of-doors, and leave exposed to the elements.

SEE THE AMAZING RESULTS



Rain, snow, changing temperature, dust and grime have eaten into and oxidized the unprotected metal. But note surface under Anti-Corrode film-bright and unharmed, in its original state.

Cities Service Anti-Corrodes are safe rust and corrosion preventives that bring amazing results. They are reliable safeguards against corrosion of metals in any form or state of finish—whether in storage or in transit. These Anti-Corrodes form a tenacious, durable film that is impervious to moisture and the more common gases prevalent in the atmosphere. And, since they contain lubricating material, they need not be removed in drawing operations. These Anti-Corrodes are made in several types to meet a wide range of service conditions. They are economical, easy to apply and can be removed with kerosene or any petroleum solvent.

(Available only in Cities Service marketing territories EAST of the Rockies.)
Available in one gallon sizes only.

Mail this Coupon Today!

CITIES SERVICE OIL COMPANY
Room 205, Sixty Wall Tower, New York 5, N. Y.

Gentlemen: I would like further information on Anti-Corrode and Rust Remover for industrial use FREE OF CHARGE.

NAME .....

COMPANY .....

ADDRESS .....

CITY ..... **STATE** .....

DEPARTMENT OF TECHNOLOGY BUFFALO PUBLIC LIBRARY

This TEAM will save you MONEY and MATERIALS

Recently, we announced the development of Cities Service Rust Remover, and the response to our demonstration offer far exceeded expectations. Rust Remover, of course, *removes* rust. Anti-Corrode is designed to *prevent* rust and corrosion. Together, they will safeguard your equipment and production!

CITIES SERVICE

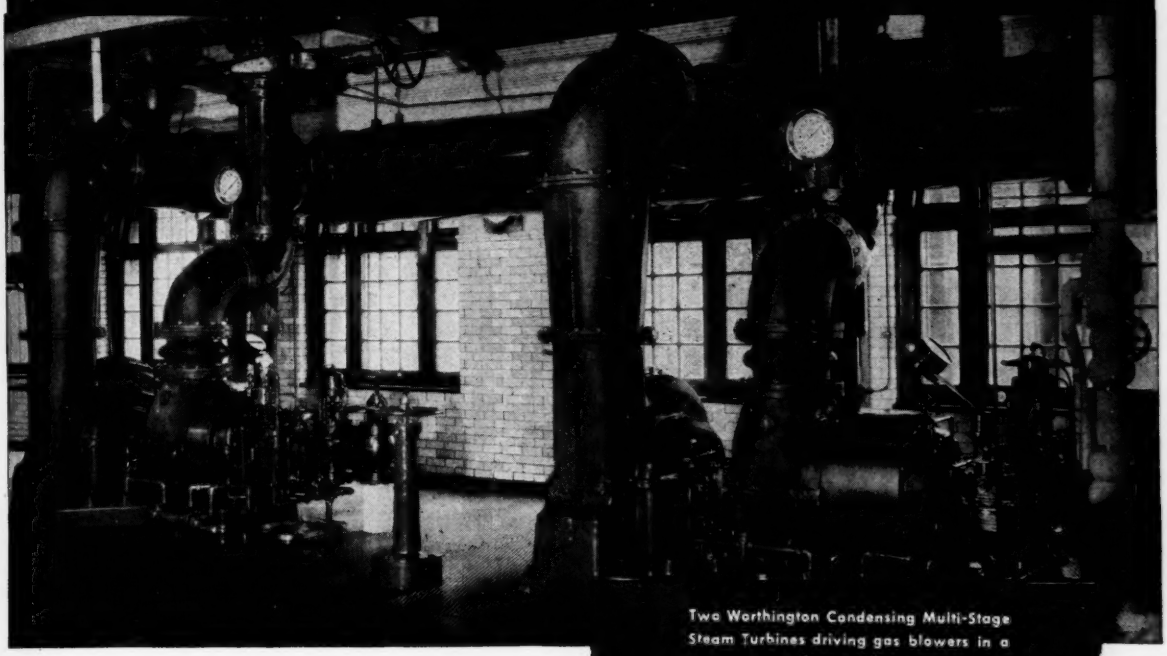
Cities Service Oil Co.
NEW YORK · CHICAGO

Arkansas Fuel Oil Co.
SHREVEPORT, LA.

XUM

MORE POWER FROM YOUR STEAM

. . . with Worthington Multi-Stage Turbines



Two Worthington Condensing Multi-Stage Steam Turbines driving gas blowers in a large utility.

You will want to investigate Worthington Multi-Stage Steam Turbines for either condensing or non-condensing service. Worthington's familiarity with all phases of steam power and specialized knowledge of Steam Turbine engineering account for *low maintenance* and *smooth, dependable economic operation.*

Low steam consumption is inherent in the design of these turbines, built in sizes from 100 HP to 10,000 HP for operation on high or low pressure steam and for speeds up to 9000 RPM. For full descriptive literature, write *Worthington Pump and Machinery Corporation, Harrison, N. J.*

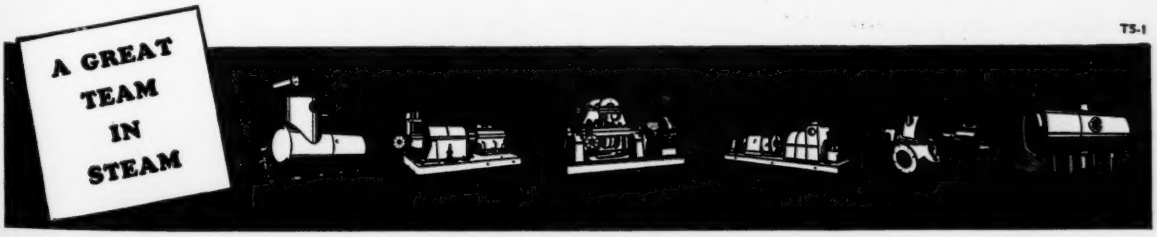
WHO USES THEM?

Worthington Multi-Stage Steam Turbines—condensing and non-condensing types — are now driving blowers, generators, pumps, line shafts, refrigeration compressors, air-conditioning units, paper machines, cane shredders, etc. Data that proves *there's more worth in Worthington* is available on request.

WORTHINGTON

TS-1

A GREAT TEAM IN STEAM



Now!
FORGED STEEL
THE LATEST DEVELOPMENT IN
CHIKSAN
BALL-BEARING SWIVEL JOINTS
CHIKSAN has adopted forged steel for all Styles and Sizes to and including 2"... in the following pressure ratings: 1,000 psi, 3,000 psi, 12,000 psi and High Temperature (700 psi, 500° F.). This important development now brings even higher quality to CHIKSAN users everywhere. It is tangible evidence of CHIKSAN's policy for continuous development in the design and manufacture of Ball-Bearing Swivel Joints for all purposes.
CHIKSAN REPRESENTATIVES IN PRINCIPAL CITIES
EXCLUSIVE EXPORT REPRESENTATIVE: CHIKSAN EXPORT CO., Brea, California
Branches: New York 7—Houston 1
CHIKSAN
TRADE MARK
BALL BEARING SWIVEL JOINTS FOR ALL PURPOSES
CHIKSAN COMPANY
BREA, CALIFORNIA
New York 7
Houston 1

WATER TUBE CLEANERS

(Continued from page 79)

vapor is coming out of the hose connecting the motor. Be sure, too, that a film of oil always is showing on the exhaust ports of the motor during operation.

Maintenance and Repair

While motors are built so that they are easily disassembled and repaired with interchangeable parts, they are, nevertheless, made to close and exacting tolerances and it is decidedly poor economy to consider loose fitting and worn parts to be "good enough". And by the broad term "loose fitting" we do not mean that the parts must rattle and shake when in contact with each other. Only micrometer measurement should be trusted unless you prefer to go to the trouble of making a brake-test.

Those parts of an air motor which demand constant attention are the front bearing, the rear bearing, the dual cylinder and the rear coupling. The front bearing is subjected to severe service and still it must be maintained within a few thousandths of an inch of clearance or the shaft will drag on the cylinder. The rear bearing is not subjected to the same wear as the front bearing and will stand up well when proper lubrication is provided.

Correct lubrication also is the key to proper maintenance of the dual cylinder providing the front and rear bearing clearance is kept below 0.006 in. There is approximately 0.004 in. clearance between the enlarged sections of the shaft and the dual cylinder seal points and as this clearance increases the power applied to the shaft decreases.

Proper pressures of air and water must be maintained if the cleaner is to operate at its highest efficiency. A length of hose, no longer than the distance between the nearest connection and the farthest tube, should be used.

Miscellaneous Notes

When each cleanout is finished inspect the cleaner and repair any damage. Then store it in a can of oil to keep parts from rusting.

Organize and train a crew to do the tube cleaning. This is far more economical than to allow a green hand to destroy cleaners and ruin tubes.

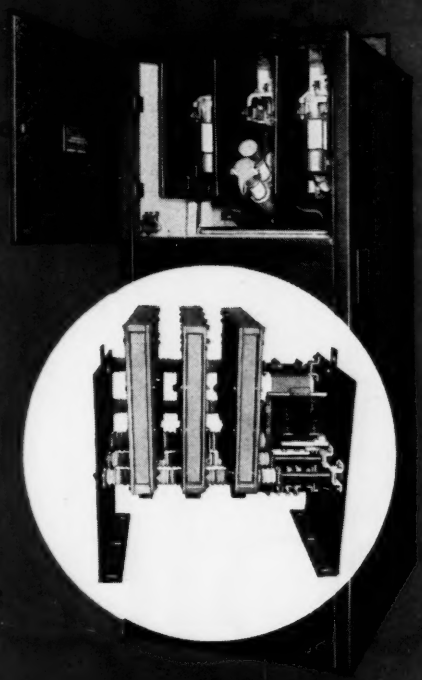
Keep your stock of repair and replacement parts at a predetermined level.

THERE is an oil well ten miles off the coast of Louisiana in the Gulf of Mexico. Another drilling platform is under construction 29 miles offshore, four others are in the planning stage within ten miles offshore, with a fifth nearly twenty miles out.

XUM

QUICK AS A FLASH!

LIMITAMP CONTROL GIVES SURE, SHORT-CIRCUIT PROTECTION



In less than *one-quarter* cycle, EJ-2 fuses in Limitamp control can cut off a rise in current from a short, and clear it in one-half cycle—long before the short has time to harm the contactor or motor. Your plant's power system needs this prompt handling of fault currents, and you will avoid the risk of costly shutdowns that can result from one, mad short circuit.

A STARTER AND PROTECTOR IN ONE CABINET

G-E Limitamp control consists of an airbreak contactor (the motor starter), and EJ-2 fuses (the short-circuit device). They are mounted in separate compartments of one, all-steel cabinet.

Airbreak contactors are specially designed for hard duty. Operating experience has proved they furnish reliable, low-cost service with only routine maintenance.

Because they operate in air, they eliminate the problem of handling oil. And tip life of airbreak contactors is many times that of comparable oil-immersed tips.

You can depend on EJ-2 fuses for sure, short-circuit protection. They are "fail-safe" devices. There is nothing about them to wear. They are easy to replace.

OVERLOAD AND UNDERVOLTAGE PROTECTION

Isothermic overload relays, accurately calibrated against actual motor characteristics, guard the motor against overheating from sustained loads or single phasing.

FACTORY-ASSEMBLED CONTROL

Factory-assembled in one cabinet, Limitamp is easy to install, easy to co-ordinate with other control, saves space, and improves the appearance of your plant.

The Trend is to **AIR**

GENERAL ELECTRIC

Apparatus Department,
General Electric Company, Section F 676-250
Schenectady 5, New York

Please send me Bulletin GEA-4247 on Limitamp control.

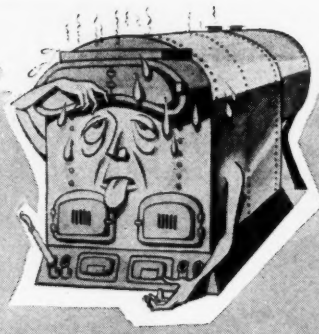
Name.....

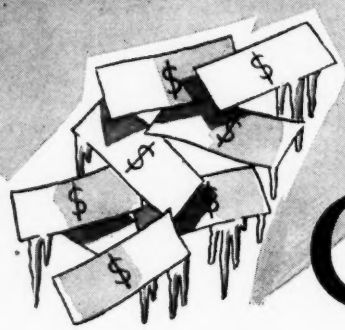
Company.....

Address.....

DEPARTMENT OF TECHNOLOGY
BUFFALO PUBLIC LIBRARY

hot spots pay off in cold cash





when you insulate with B-H Mono-Block

Send for Sample

On boilers, ovens, furnaces, tanks—wayward BTU's are costing you money. Stop this heat loss with Baldwin-Hill Mono-Block and you earn four extra dividends in the bargain.

DIVIDEND #1—Mono-Block stands up under severe service, up to 1700° F—because it is produced of resilient, heat-resistant fibres of *black* Rockwool.

DIVIDEND #2—Mono-Block has exceptionally high efficiency providing extra insulating protection thanks to the patented felting process used in its manufacture.

DIVIDEND #3—Mono-Block saves time and material—*one block* efficiently serves the full temperature range to 1700° F.

DIVIDEND #4—Mono-Block is easy to install—fits snugly over rivet heads and other irregularities, cuts to shape with a knife where necessary.

The coupon brings descriptive literature and a sample.

Baldwin-Hill Company
515 Breunig Avenue
Trenton 2, N. J.
Send free sample of B-H Mono-Block and data book "Industrial Insulations"

Name.....Position.....
Firm.....
Address.....
.....

DEPARTMENT OF ENGINEERING
BUFFALO PUBLIC LIBRARY

OTHER B-H INSULATION MATERIALS

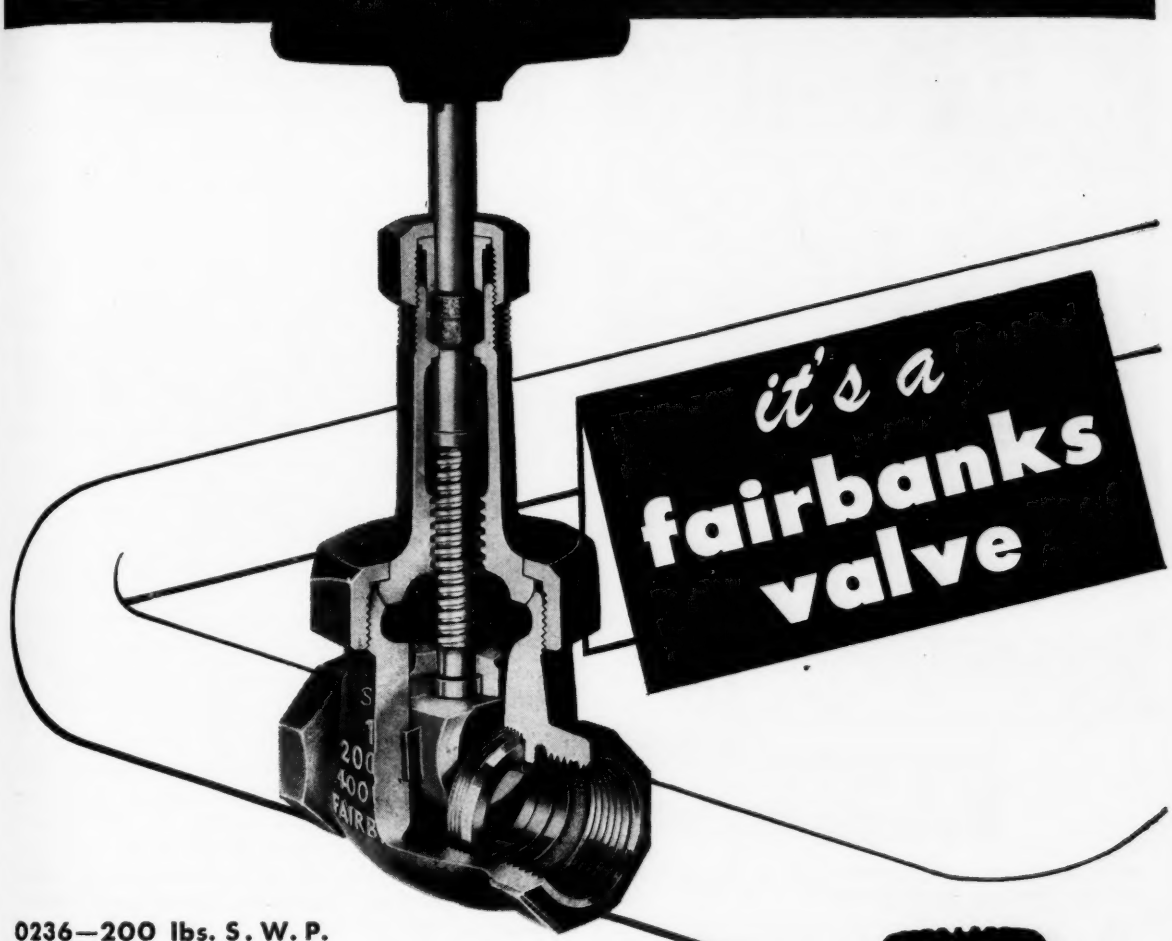
B-H No. 1 Cement—a fast-covering, rust-inhibited plastic insulation effective to 1800° F. **B-H Blankets**—For wrap-around insulation of large areas, effective to 1200° F. **B-H Weatherseal**—A weatherproof compound for protecting insulated surfaces.

Baldwin-Hill

Specialists in Thermal Insulation

XUM

SET for the life of the line

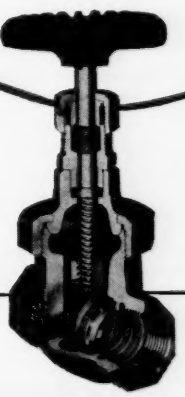


it's a fairbanks valve

0236—200 lbs. S. W. P.

UNION BONNET BRONZE GATE VALVE

Engineered in every detail to provide maximum service under the toughest operating conditions. Hard nickel alloy seats and wedges resist corrosion. Union Bonnet (with heavy octagonal nut) assures great strength, 100% tightness under pressure, yet permits quick, easy dismantling for cleaning and inspection. To eliminate high maintenance costs, shutdowns or other operating problems, install Fairbanks Union Bonnet Bronze Gate Valves. Recommended for steam (200 lbs.), water, oil or gas. Sizes ½" through 2". The Fairbanks Company, 393 Lafayette St., New York 3, N. Y.; 520 Atlantic Ave., Boston 10, Mass.; 15 Ferry St., Pittsburgh 22, Pa.; 748 M & M Bldg., Houston 2, Texas.



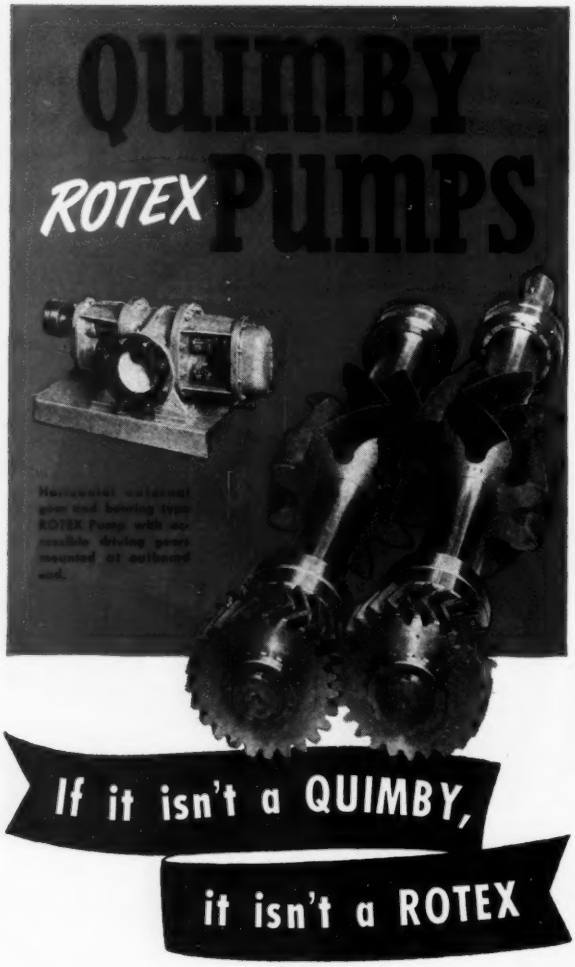
0232

UNION BONNET BRONZE GATE VALVE

Non-Rising Stem.

All parts interchangeable with Rising Stem Type. Sizes ½" through 2".

American industry flows through fairbanks valves



Only QUIMBY can make a ROTEX pump. If it's a genuine ROTEX, it has these seven advantages:

1. Full herringbone driving gears for quiet, efficient, smooth transmission of power.
2. Full herringbone rotors for pumping only . . . no contact between rotors . . . no wear except from liquid pumped.
3. Extra-deep stuffing box with space for 6 to 8 rings and seal cage.
4. Every Quimby Rotex is thoroughly engineered for each job application and service-tested at the factory.
5. Oversize precision anti-friction bearings for close tolerance . . . no misalignment due to wear.
6. Heavier body construction.
7. Extra heavy shafts.

QUIMBY PUMP DIVISION PORTER "Better Built" EQUIPMENT

REMEMBER, THERE IS NO SUBSTITUTE FOR A QUIMBY
Experiments are costly! Be sure it's a genuine ROTEX. Quimby has been making pumps exclusively since 1894.

H. K. PORTER COMPANY, Inc.
Quimby Pump Division
PITTSBURGH 22, PENNSYLVANIA
District Offices in Principal Cities

LIGHTWEIGHT all-plastic safety goggle with air conditioned eyecups to reduce fogging of lenses, affords large area of protection, provides wide angle vision, with light weight well distributed.

★ ★ ★

RESISTANCE to high temperatures (900 to 1600 deg F) and to corrosion without scaling or discoloring characterizes aluminized steel formed by applying molten aluminum to both sides of sheet steel; can be welded, bent without peeling or flaking, holds paint better than galvanized steel.

★ ★ ★

TANKS FOR HEATING, melting, dipping, pouring any wax, fat, pitch, paraffin, oil, hydriline, battery resistor or capacitor compound constructed on double boiler principle to insure uniform temperatures, have built-in thermostatic controls holding temperature rigidly at set point between 100 and 550 deg F. Gas-fired or electrically-heated available, latter in 15 and 40-gal sizes.

★ ★ ★

PROVIDING INSULATION against stray and long-line electric currents that flow from connecting pipeline into uninsulated well structures or tanks, eliminating pipe joint corrosion caused by active galvanic cell set up there, plastic ring seal gasket has high strength high dielectric laminatex plies of fiberglass cloth impregnated with phenolic resin precision-molded under high pressure and high temperature. Available in all standard pipe sizes.

★ ★ ★

PIPE DOWN to 24-in. diameter can be concrete lined in place, applied centrifugally through dispensing head that throws measured amount for each foot of machine advance. Revolving trowels smooth it to give hard-finished surface resistant to electrolysis and tuberculation. One man rides trailer, inspects and controls operations. Machine is smaller counterpart of units used on 30 to 84-in. diameters in recent years.

★ ★ ★

SMOKELESS coke-like fuel made from Utah semi-bituminous coal has high available Btu's and low percentage of volatiles, produced at 75 cents to $1.25 a ton plus tar, benzene, coal gas, will sell at 1½ times soft coal price. For the present entire 100 tons a day will be marketed in nearby northern Utah. Plant layout per its early expansion to 500 tons a day. Many distinct advantages besides cheapness. Expansion may include processing of by-products.

★ ★ ★

INEXPENSIVE PROTECTION for pipes, valves, fans, rotors, intricately-shaped parts, applied by dipping, spraying or brushing, Liquid Tygoflex, 100 per cent solids, no volatiles, is applied, converts to thick protective insulator like glossy black rubber composition of medium hardness. Readily handled, applied to any surface or material that will withstand time and temperature involved in fusion of metals, ceramics, glass, etc., resistant to dilute or concentrated mineral acids, alkalies, salts, oxidizing agents, limited range or solvents.

XUM

150 HP Cyclotherm Steam Generator

We Harness the Cyclone's Force

The furnace tube of a Cyclotherm Steam Boiler in operation houses a cyclone of fire—safely and automatically controlled. By applying to combustion the same principle that gives a ruthless "twister" its destructive power, Cyclotherm engineers offer the world a new and better steam boiler, one that does more efficient work for you at less cost than you have ever known.

The patented Cyclotherm method consists of burning the atomized fuel in a rapidly revolving cyclonic flame completely in the first pass. This highly radiant cyclone of flame travels relatively slowly through the length of the furnace tube with the result that heat is radiated intensely and uniformly.

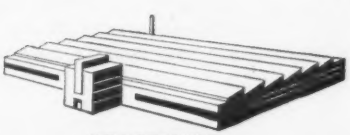
Cyclotherm units of 80 to 300 HP are equipped with an automatic modulating steam pressure control system which provides the proper quantitive fuel-air relationship for all firing rates with oil (or gas) and air pressure constant. Firing rates are modulated from 30% to 100% of rated capacity in response to steam demand. Units of 10 to 60 HP utilize the "on-and-off" method of operation which is immediately responsive to thermostat or pressure control and is more economical on small boilers. Both methods of firing are guaranteed 80% efficient.

Cyclotherm units are manufactured in sizes from 10 to 300 HP with operating pressures from 15 to 200 psi and a steam output of from 345 lbs. per hour from feed water at 212° F to 10,300 lbs. per hour. For greater steam requirements, a battery of Cyclotherms is recommended.

Prompt factory delivery assured.

For further information write for our specially prepared booklet 317Z

POWER

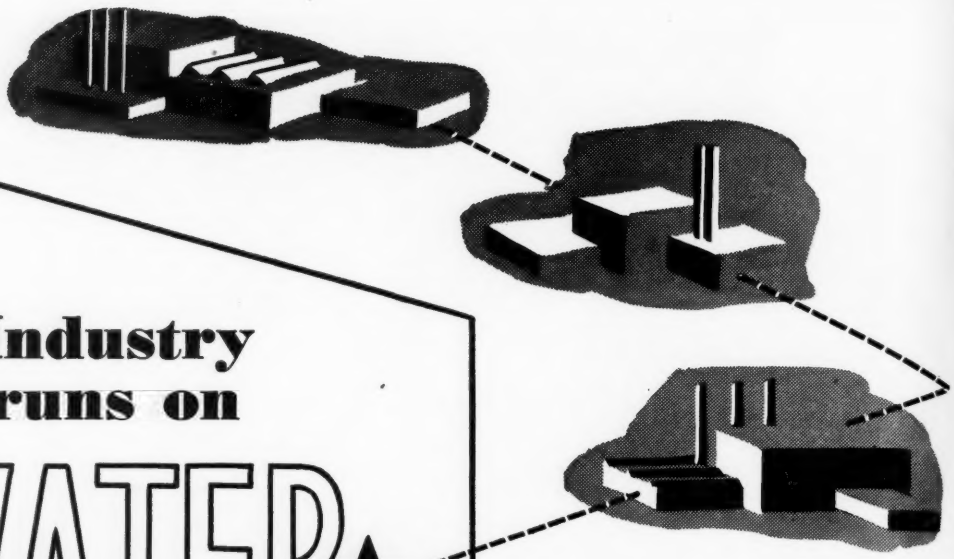


PROCESSING

HEATING

CYCLOTHERM STEAM GENERATORS

CYCLOTHERM CORPORATION, 90 BROAD STREET, NEW YORK 4, N. Y.

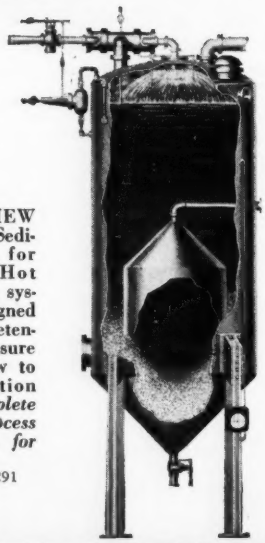


Industry runs on WATER

BUT WATER IS SELDOM SUITABLE FOR INDUSTRIAL PURPOSES WITHOUT SOME KIND OF TREATMENT

PREVENTION of scale, carryover and corrosion in power plants depends on the proper treatment of boiler feedwater. It means using the right kind of water conditioning equipment and chemicals, selected only after carefully considering such factors as the character of the raw water, amount of make-up, type of steam load, and the design characteristics of steam generators and prime movers. These and other essential considerations demand that you place your water conditioning problems in the hands of experienced experts who can select impartially from a complete range of water conditioning equipment.

Allis-Chalmers long and extensive experience in conditioning boiler feedwater for thousands of power plants — both high and low pressure — qualifies them to assist you in selecting the right kind of water treating equipment for your plant. Their "know-how," coupled with the complete range of Allis-Chalmers water conditioning equipment, is your assurance of the right solutions to your water treatment problems.



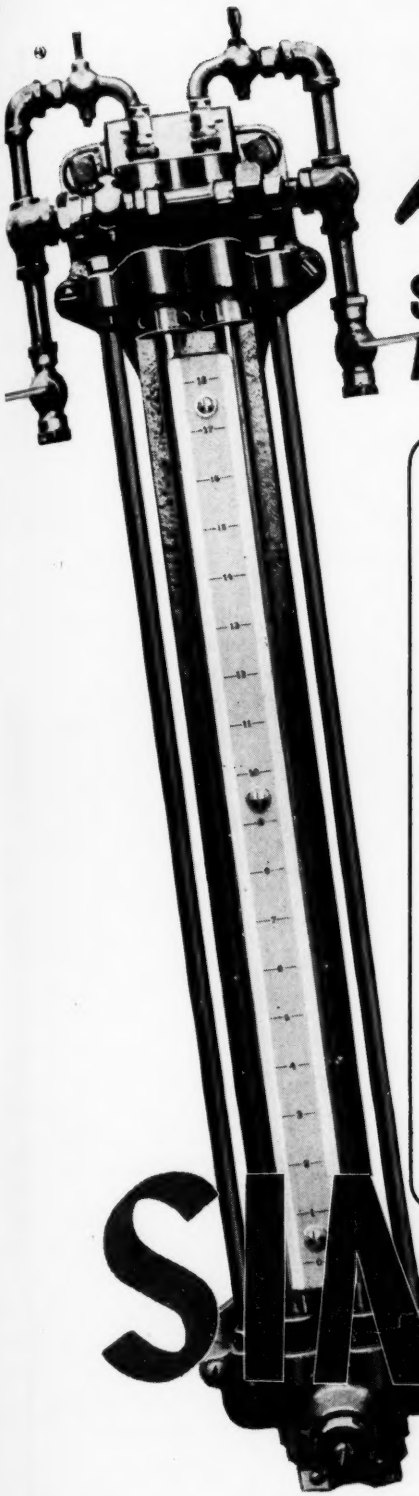
SECTIONAL VIEW of Reaction and Sedimentation tank for Allis-Chalmers Hot Process Softening system. Tank is designed to allow ample retention time . . . insure straight-line flow to minimize convection currents. *For complete details on Hot Process Softeners, write for Bulletin 28B6611.*
A 2291

Whatever your water conditioning requirements are, Allis-Chalmers can supply the proper equipment . . . Hot and Cold Process Softeners . . . Sodium and Hydrogen Zeolite Softeners . . . Degasifiers . . . Deionizers . . . Chemical Proportioning and Feeding Equipment . . . Chemical, Booster and Filter Backwash Pumps . . . Oil Removal and Water Filters. Call your nearest A-C office or write: ALLIS-CHALMERS, MILWAUKEE 1, WIS.

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

1847 1947 A CENTURY OF SERVICE to Industry THAT MADE America Great



here's how

SIMPLEX TYPE MAP MANOMETERS ASSURE MEASUREMENT ACCURACY!

Be sure of accuracy — with a Simplex Type MAP Manometer! This unit has been designed especially to meet the high standards of laboratory technicians, test floor engineers, and other industrial users *where accuracy is a "must"!* Here are six of the special features of the Type MAP Manometer:

1. ***Large-diameter gauge glasses*** with accurately bored interior surfaces tending to produce a flattened meniscus!
2. ***Highly accurate scale*** permitting deflection readings of 1/100 of an inch!
3. ***Mercury dampening valve*** — essential in removing oscillations caused by line surges!
4. ***Mercury drain and filling plugs*** — for quick addition or removal of balancing liquid!
5. ***Air venting valves*** — for instant removal of air accumulations!
6. ***All-important equalizing valve*** — to enable checking and testing of instrument in place—at any time.

Want installation, operation facts? Write for free, illustrated copy of BULLETIN 200

SIMPLEX

TYPE MAP MANOMETERS
for application with Venturi Tubes, Flow Nozzles, or Orifice Plates.

SIMPLEX VALVE & METER COMPANY

6783 UPLAND STREET, PHILADELPHIA 42, PA.

XUM

FOR ACCURATE FLUE GAS CONTROL

HEACON DAMPERS

One of the more simple, yet highly important applications of the Heacon Damper is as an uptake damper where two or more boilers are served by one stack.

Illustrated here is a single Type I Thermix stack and Tubular dust collector, serving two boilers, regulated by SVH Type Heacon Dampers.

Heacon Damper tightness results in fuel savings during banking hours, reduction of temperature strain, shortened outage time for maintenance and improvement in automatic draft regulation. These are only a few of the advantages gained from such an installation.

The secret of Heacon Damper tightness is its flexible curtain held firmly against seals on the damper frame by the flow. This construction gives tight shut off without binding and, by the addition of V-porting, permits the accurate control of the smaller increments.

These advantages can mean savings to your plant. Why not call our Field Engineer nearest you? He'll be glad to help you solve your draft control problem.

FIELD PROJECT ENGINEERS

ATLANTA, GA.
C. E. Johnson & Associate
Bona Allen Bldg.

BOSTON 10, MASS.
Thermix Engineering Co.
89 Broad St.

BUFFALO, N. Y.
Johnston Engineering Co.
1200 Niagara Street

CHARLOTTE 2, N. C.
T. C. Heyward
1408 Independence Bldg.

CHATTANOOGA 2, TENN.
Edgar A. Rogers
Chattanooga Bank Bldg.

CHICAGO 5, ILL.
Engineering Sales Co.
1307 S. Michigan Ave.

CINCINNATI 2, OHIO
F. Eliman
Chamber of Com. Bldg.

CLEVELAND 15, OHIO
H. W. Kaiser Co.
1836 Euclid Ave.

DETROIT 2, MICH.
Metrol Co.
5538 Cass Ave.

DULUTH, MINN.
A. H. Kennedy
214 First National Bank Bldg.

HOUSTON, TEXAS
J. A. Rossiter Co.
P. O. Box 1095

KANSAS CITY, MO.
F. W. Hay & Co.
2734 Cherry St.

LOS ANGELES, CALIF.
A. W. Anderson
164 S. Central Ave.

MINNEAPOLIS 2, MINN.
Hoyt A. Sevey
314 S. 9th St.

MONTREAL, CAN.
T. C. Chown, Ltd.
1440 St. Catharine St., W.

NEW HAVEN 5, CONN.
Daniel Smeriing
P. O. Box 1169

NEW ORLEANS, LA.
Arthur C. Hays
221-23 Carondelet Bldg.

NEW YORK 7, N. Y.
Parry Engineering Co.
154 Nassau St.

PHILADELPHIA 3, PA.
Thermix Engineering Co.
Room 1003
Broad Street Station Bldg.

PITTSBURGH 19, PA.
Herr-Harris Co.
545 William Penn Way

RICHMOND 1, VA.
Frank Howell Co.
Room 412, American Bldg.

ROCHESTER 4, N. Y.
Johnston Engineering Co.
31 Gibbs St.

ST. LOUIS 8, MO.
Economy Equipment Co.
4526 Olive St.

SALT LAKE CITY 9, UTAH
The Lang Co.
267 W. First South

SAN FRANCISCO 4, CALIF.
S. Herbert Lanyon
58 Sutter St.

SCHENECTADY 4, N. Y.
D. R. Whipple
1550 State St.

SEATTLE 4, WASH.
Lewis, Watts & Freeman, Inc.
Room 520
905 Second Ave. Bldg.

WASHINGTON, D. C.
T. W. McGuire Co.
Bond Bldg.

HEACON

THE THERMIX CORPORATION

Project and Sales Engineers

FIRST NATIONAL BANK BLDG., GREENWICH, CONNECTICUT

THE BATTLE AGAINST HIGH COSTS

STARTS IN YOUR BOILER ROOM...

• In a general survey of your operations with a view to reducing costs, the logical place to begin is in the boiler room. Here you will find immediate opportunity to make money through the installation of CASH STANDARD Automatic Combustion Control.

When this installation is made you save fuel and have more steam with less fuel and all this with your present boiler.

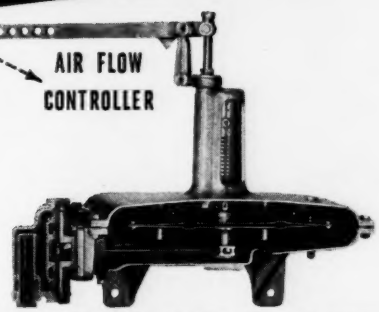
The reason for this is that with CASH STANDARD Automatic Combustion Control you maintain correct fuel feed — the correct fuel-air ratio, and constant over-fire draft.

Read Bulletin No. 300. It gives interesting details on the operation of these units. Also tells how CASH STANDARD Units can be combined to make a dependable, cost-saving Automatic Combustion Control System that meets all conditions and that works on any boiler or stoker with any kind of fuel.

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

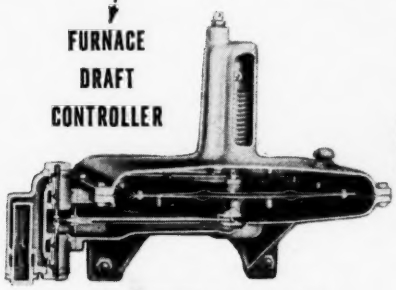
MAKE IMMEDIATE AND CONTINUOUS SAVINGS WITH THIS EQUIPMENT

AIR FLOW CONTROLLER

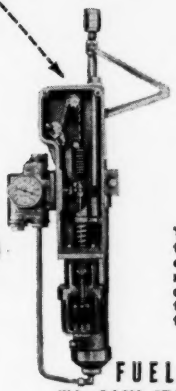


This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

FURNACE DRAFT CONTROLLER



This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from over-fire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

A. W. CASH COMPANY

DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

PREVENT

Rust·Scale·Dirt

FROM CLOGGING
STEAM EQUIPMENT

YARWAY

STRAINERS

"The Screen's the Thing"

- *A High Grade Monel Woven Wire Basket* with mesh fine enough to catch the dirt—yet ample free area for passage of clean condensate, oil and other fluids.
- *Body Cadmium Plated for Protection Against Corrosion and for Better Appearance.*
- *Readily Removed Steel Blow-Off Bushing.*
- *Bushing Automatically Aligns Screen.*
- *Thousands in Use—Sold by Nearly 150 Supply Houses.*
- *6 Sizes ½" to 2" for Pressures up to 600 lbs.*

See Your Supply House or write for Bulletin S-201

YARNALL-WARING COMPANY

114 MERMAID AVENUE PHILADELPHIA 18, PA.

YARWAY STRAINERS

ELECTRIC POWER AND NATIONAL DEFENSE

(Continued from page 67)

never allow this lesson to go unheeded again.

Political ideology and surprise action put the smallest of the three major industrial areas into the hands of the Insurgents during the first week of the Spanish revolution, and severed contact, by wide areas, between the other two major areas. Then the Rebel offensive crumbled against Madrid — presaging Stalingrad and developing the unexpected fact that ruins of a modern city are excellent field fortifications. For a year little advance was made. Yet one very important change did occur. The major power plants supplying the Biscayan area were seized. Resistance gradually weakened here until a mere shell received the final impact that brought about Insurgent control of all northwestern Spain.

Capture of Hydro Plants Won War

The Catalonian area still continued to pour out war materiel—small in quantity compared to that of predominately industrial nations, to be sure. But it did sustain the Madrid defense, and held the Insurgent forces in check.

There now was conceived a most brilliant stroke of military genius. This was the campaign to seize the hydro power plants supplying Catalonian industry, thus causing production to wither.

Instead of driving down the river from Zaragosa to the sea, and spreading over the plains — an operation which would have been a classical pattern—thus over-running both the industrial area of Catalonia, and the so-called "bread basket" of Spain as well, a campaign was inaugurated that still brings sharp criticism from many competent critics notwithstanding its success.

The Insurgents started a major drive north from Zaragosa, thence eastward, parallel to, and near the French border—driving over terrain most unsuited to military operations. It moved, not along the valleys, and ridges, but thwartwise. It entered the valleys, not at the mouth, but at the head, thence driving downward. This put logistic advantage heavily in favor of the Loyalist forces—temporarily, at least.

But soon the important hydro station of La Fortunado, badly damaged, changed hands. Then by a difficult construction feat, the power that had been flowing to Barcelona was reversed and sent to Bilbao to rejuvenate industry now in the hands of the Insurgents. If time permitted there are many incidents like that of the bronze runner, driven from its shaft by sledge hammers, dragged down the mountain side by teams of oxen, abandoned in close pursuit, recovered, and returned to its place, its efficiency not too greatly reduced by

LADISH *Controlled Quality*

...WHAT IT MEANS IN DEPENDABILITY AND LONG SERVICE FROM PIPING SYSTEMS

Controlled Quality is the distinguishing feature of every product in the complete Ladish line. Seamless Welding Fittings, Forged Steel Fittings and Forged Steel Flanges . . . all are produced under exacting metallurgical control and rigid inspection of physical dimensions.

Ladish Controlled Quality . . . made effective by one of the most modern and completely equipped metallurgical engineering laboratories in the industry . . . provides complete determination of chemical composition and physical properties of steel together with constant application of proper forging procedures and heat treating.

Thus users of Ladish Fittings and Flanges obtain high dynamic strength . . . uniform toughness . . . and assured resistance to shocks, strains and stresses common in piping installations. Advantages resulting from Ladish Controlled Quality provide the ultimate economy of long life and dependability.

A COMPLETE LINE PRODUCED UNDER ONE RESPONSIBILITY

Ladish catalogs, to assist in the design of piping installations and the proper selection of fittings and flanges, will be supplied upon request.

TO MARK PROGRESS

Controlled Quality
FITTINGS

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES:
New York • Buffalo • Pittsburgh • Cleveland • Chicago • St. Louis • Atlanta • Houston • Los Angeles

PUT STEAM
FULLY TO WORK

...By-Product Power

THE ENGINE PAYS
FOR ITSELF AFTER A
FEW MONTHS ON THE JOB!

If you use steam for heating or processing you can probably cut power costs by installing a Troy-Engberg Steam Engine and using By-Product Power to drive stokers, generators, compressors, pumps or blowers.

With proper plant heat balance you use steam direct from the boiler to run the engine and THEN introduce the exhaust into your processing or heating. The engine acts as a reducing valve, producing POWER at the same time. It's By-Product Power. It's exceptionally cheap power.

Consult our engineers about saving with By-Product Power.

TROY ENGINE & MACHINERY COMPANY
Established 1870
800 Railroad Avenue Troy, Pennsylvania

TROY-ENGBERG
STEAM ENGINES • GENERATING SETS • GENERATORS

the battering it had received, and put to work pumping power westward. But even more thrilling incidents occurred further to the east. The drive entered the headwaters of the Flamisel high above Cataluna, newly finished, with its 30 megawatts. Thence southward, to its junction with the Palleressa, and Pobla control station.

Thus more than 40 per cent of the power supply of Catalonia was interdicted. The objective of the campaign was clear now, and the Loyalists began a struggle to save Camarassa and Tremp and other downstream developments. These were the last important plants remaining in Loyalist hands. Camarassa dam was wedged in a precipitous gorge; its penstock and tunnel were cut into solid rock; the power house itself was almost hidden beneath a cliff. Its roof was reinforced to withstand rock fall. It now became the center of terrific fighting. Not heavy fighting, for the terrain was too constricted, but carried out with all the fierceness, and cruelty that fratricidal war can develop. Infantry surged back and forth across the dam, and through the power house. The output went first to Barcelona then to Zaragosa—and at times to both.

Engineers built ponton bridges, and other engineers released surges of water to wash the bridges away. Bombs dropped on the roof, and destroyed switchgear and insulators. Not tiny bombs but heavy. One 2000-lb bomb scored a direct hit. Even that did not long stop output. After several weeks, an infantry man threw a hand grenade into a queer hole reaching into the interior of the dam. This destroyed the gate control mechanism and the stored water was released. So Camarassa was useless for at least a season. The Loyalists withdrew, and a few more smaller stations were occupied by the Insurgents. They then sat down and waited. There was little fighting, merely a steady pressure. But in less than half a year, without the munition output of Catalonia, the Loyalist government collapsed.

This campaign was won with battle casualties a mere fraction of what they would have been had the classical pattern been followed. Nor had the country been devastated. Yet one phase incident to the campaign did result in devastation. Loss of water from the Camarassa dam materially reduced food production in the Valley of the Ebro. And to effect capture of Seros power house, the ancient head gates at Lerida were destroyed, turning much of the famed "bread basket" into a desert. The striking power of an enemy was destroyed because munitions did not reach the front. And munitions did not come forward because no electric power was available for their manufacture.

Now as to these lessons not learned. First, and most important,

B. t. u. Savers

FLOW METERS

Electrical Remote Reading Type

Republic electrical type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 10,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments—indicator, recorder and integrator—are of the remote reading type.

WRITE FOR DATA BOOK No. 701

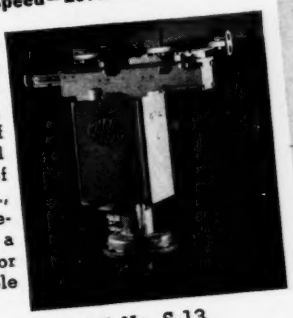
RECORDING THERMOMETERS

Republic thermometers are available for recording temperature of flue gas, temperatures in vats or tanks either open or closed and under pressure. For unusual conditions, special bulbs are furnished of corrosion resisting metal or with a protective coating.

WRITE FOR DATA BOOK No. 210

REGULATORS

Pressure—Flow—Speed—Level—Ratio



Republic hydraulic or pneumatic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, level of a liquid or the proportioning of two pressures, flows, etc., in a fixed ratio by mechanically operating a valve, damper, rheostat or various types of variable speed transmissions.

WRITE FOR DATA BOOK No. S-13

PNEUMATIC TRANSMITTERS

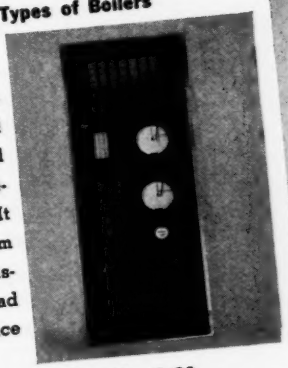
Operating On The Force-Balance Principle

Republic pneumatic transmitters are devices for converting process variables, such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables. These air pressures can be used as the measuring impulse for the actuation of an automatic controller or a direct reading recorder.

WRITE FOR DATA BOOK No. 1000

COMBUSTION CONTROL

For All Sizes and Types of Boilers

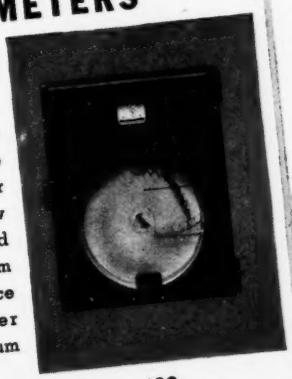


Republic automatic combustion control is available for all sizes of boilers, all types of fuel firing, all load conditions and any arrangement of draft equipment. It maintains constant steam pressure, highest combustion efficiency, desired load division, constant furnace draft.

WRITE FOR DATA BOOK No. S-21

BOILER METERS

Record Steam Flow-Air Flow



The Republic Boiler Meter records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion. The air flow pen is adjusted to record coincident with the steam flow pen when the furnace is receiving the proper amount of air for maximum combustion efficiency.

WRITE FOR BULLETIN No. 420

DRAFT AND PRESSURE INSTRUMENTS

For indicating and recording drafts, pressures and differentials, Republic dry-bellows type indicators and recorders are supplied for all ranges encountered in furnace operation, in any desired combination.

WRITE FOR BULLETIN No. 802.

Republic Flow Meters Co.

2240 Diversey Parkway — Chicago, 47, Illinois

Damper Regulators

TEMPERATURE REGULATORS

ATLAS

TRADE MARK REG.

What Is Your Boiler Pressure?

25 psi or less? No. 501 automatically regulates drafts of vapor or low pressure steam heating boilers. Can be adjusted to operate at any steam pressure up to 25 pounds.

Up to 150 psi? No. 502 is the regulator pictured below. For boiler pressures up to 150 pounds. Will move damper on boiler pressure changes of ¼ pound.

400 or less? No. 503 has a Cast Iron Base construction for boiler pressures up to 250 pounds. Cast Steel Base construction for boiler pressures up to 400 pounds. Moves damper on ½ pound boiler pressure variations.

Two Worth While Features

1. *On forced draft boilers ATLAS Damper Regulators may be arranged to control fan speed. From the fan they may be made to regulate indirectly the feed rate of the stokers.*

2. *Proper and automatic adjustment of drafts and dampers keeps CO_2 where it* **should** *be. CO is avoided. Fuel is saved and flue gas temperatures are kept down where they belong for maximum operating efficiency.*

Bulletin 4-A Tells All

This Bulletin explains in full why ATLAS Damper Regulators are so valuable on boilers of nearly every size and type. You can get a copy by using the coupon below. Also, note the other ATLAS products listed in the coupon.

Sensitive—Hydraulic—Automatic

The heaviest doors or dampers are easily and quickly moved by these remarkable regulators. Ample power is always available. Water pressure is made to act automatically on a piston that is connected to the draft doors or dampers by chain. The control piston simultaneously responds to the slightest variation in steam pressure so that uniform pressure is maintained through closest adjustment of dampers. Also there is a resulting steady rate of combustion. These Damper Regulators are easy to install.

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

Specialists in Regulation for Nearly a Half Century

291 South St., Newark 5, N. J.

Represented in Principal Cities

ATLAS VALVE CO., 291 South St., Newark 5, N. J.

☐ Please send Bulletin No. 4-A on ATLAS Damper Regulators. Also, please send information on the following Atlas Products.

☐ CAMPBELL Boiler Feed Regulator
☐ Temperature Regulators
☐ Reducing Valves
☐ Exhaust Control System
☐ Pressure Regulators
☐ Pump Governors
☐ Float Valves
☐ Humidity Controllers
☐ Thermostats
☐ Balanced Valves
☐ Control Valves
☐ Oil Control Cocks

Name .....
Firm .....
Street .....
City ..... State .....

an army in the field can be destroyed by withering if the electric power supplies of its industrial base can be cut off.

Second; only a concerted, completely coordinated attack will destroy a power system well integrated.

Third; power system objectives must be selected by power engineers, familiar with operating details, as well as general perspective.

Fourth; ordinary bombs are seldom effective against power plants. Armor piercing bombs are essential to reach vital parts.

Fifth; even a small projectile, if it reaches a vital part will destroy the effectiveness of a large power system.

Sixth; every power house serves a certain area, circumscribed by economic and physical laws. Complete military protection requires that inter connection with every adjacent area be strong enough to carry full load if the serving power house is destroyed.

Seventh; no power house should supply such a large portion of any area that it becomes a predominately profitable target object for enemy attack.

Eighth; reserves are the very essence of successful national mobilization.

These lessons are deduced from a small war—an inconsequential war from a military point of view. But every one is documented many times over, usually by a failure of some type in every campaign in every theatre of the World War II. Suffice it to say, that in the highest echelon of the Axis Command, fear of a concerted, coordinated attack on the power systems was ever in mind. And the universal comment to postwar interrogation of their officials, both civilian and military, was that such an attack would have shortened the war measurably.

And for you gentlemen, who are designing, building, and operating the power systems of this nation—systems that by the law of probabilities will bear again the burden of defense—a look into the future may be worth while.

Will our cities be devastated in the early hour of the war? That may be. But quick strikes back will wreak an equal devastation to the enemy. Victory will come, as always, to the nation that has resiliency to recover from its blows—and build an industrial striking force that will enable its troops to overpower their adversary. How long that will take cannot be foreseen. If the adversaries are reasonably matched, it may be years. But of one thing we can be sure. **Never again will this nation be able to organize its military might behind the fortification of distance.** Even though the issue be joined politically overseas, long range weapons, be they guided missiles, or conventional bombers, will subject us from the

DEPARTMENT OF TECHNOLOGY BUFFALO PUBLIC LIBRARY

How Cooling Requirements Calling For A Compact, Lightweight, Versatile Unit

ARE FILLED PROMPTLY FROM STOCK

Widespread use of small, lightweight Ross "BCF" oil and water coolers for Diesels, compressors, hydraulic presses, torque converters, reduction gears and turbines REQUIRES MASS PRODUCTION OF PARTS AND ASSEMBLY LINE METHODS to keep current with the needs of industry.

Thus, quantities of those sizes in greatest demand are carried in stock for immediate shipment.

Save time! Save costs! Check with your nearest Ross representative (or the main office) on filling your requirements from stock. Our Monday morning stock lists show how many of each size can be shipped within 24 hours . . . and you'll be quoted from published price and discount lists.

- √ STRONG, DURABLE
- √ CORROSION RESISTANT
- √ ALL NON-FERROUS MATERIALS
- √ HIGH HEAT TRANSFER RATE
- √ EASILY INSPECTED AND CLEANED
- √ SIMPLE TO INSTALL

ROSS

'BCF' COOLERS

ROSS HEATER & MFG. CO., INC.

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

1428 WEST AVENUE **BUFFALO 13, N. Y.**

Ross Equipment Is Manufactured and Sold in Canada by Horton Steel Works, Ltd., Fort Erie, Ontario

This Spool Stops DROOL in FARRIS SAFETY-RELIEF VALVES

This valve keeps a tight seat with never a sizzle . . .

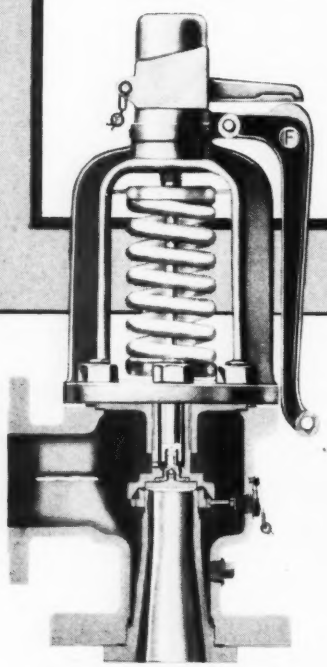
Because:

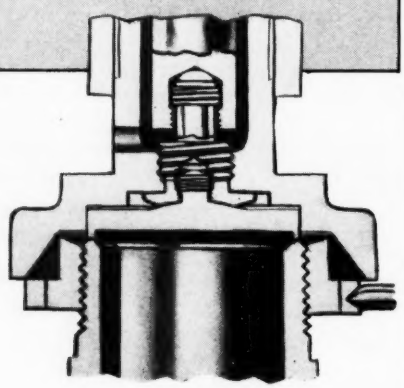
- **The double universal joints in the alignment spool — a hardened steel piece threaded into the disc — holds disc and stem in perfect alignment with each other and also with the 2½ to 1 ratio guide cylinder. No cramping is possible and the disc always seats firm and true with a smooth, easy action.**

Type 2575
Safety Valve
for
Boiler
Installations

Other cost saving advantages:

- **The small center disc piece which takes all the beating can be easily replaced for a few dollars when necessary without replacing the whole assembly.**
- **The inverted cone or secondary nozzle retains its full certified capacity without need of adjustments which always causes loss of capacity. This fact coupled with a coefficient of flow efficiency established at 97½ means that a smaller valve can be used.**
- **Minimum stock parts need be carried because such parts are completely interchangeable.**





The Spool

For sizes and capacities and further details write for your copy of the new Farris Catalog.

FARRIS ENGINEERING CORP.
400 Commercial Ave.
Palisades Park, N. J.

Farris

SAFETY and RELIEF VALVES

FARRIS keeps pace with advancing power and process engineering

1249

first day to a devastation this nation has never known.

What will be the pattern of power destruction? Some of course will be the result of area bombing. But more will be caused by precise attack against specific power targets. What targets?

Certain military engineers feel sure that generating stations will be the choice—that within 24 hours Grand Coulee, and Boulder, and Wilson, and Philo, and Powerton, and Niagara and a dozen other landmarks of the industry will be crippled so badly that many months, perhaps years, will be required for restoration. Such an eventuality would be crippling in the extreme.

Others hold that the chief reason for attack would be to secure our material wealth, and objectives would be selected whose disablement, while crippling, could be restored in a short time, even if only by improved repairs. Such targets might be important switching centers like Newark Substation near the San Francisco Metropolitan area, the East Hammond Substation of Northern Indiana, the Clinton Substation in Cleveland or the Charleroi Substation in Pittsburg. Concentrations such as these offer inviting targets.

While complete restoration would be a matter of months, temporary circuits could be improvised in a matter of hours, only to be disrupted again and again by succeeding attacks.

Final choice of method probably would be based on decision of the highest economic echelon of the enemy. Planning for National Defense should envisage both types of attack. Failure to destroy systematically the power systems of Germany has been called one of the greatest tactical errors of the late war. Be that as it may. The general staffs of all nations are awake to the implications of electric power. Its importance will not be overlooked.

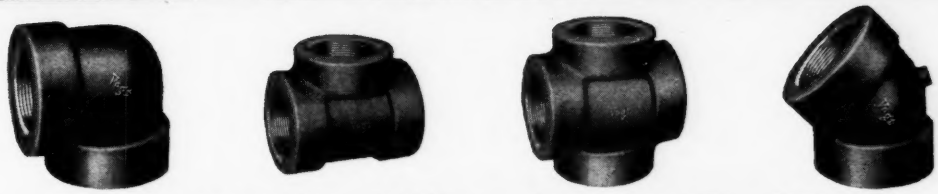
THIS TACTICAL ERROR WILL NOT BE REPEATED!

A CHEMICAL developed in wartime is a new wax-like compound that waterproofs leather. The substance does not clog the pores of the material to which it is applied. In fact, it revitalizes old leather; and shoes treated with it do not leak or sweat inside.

GLOWING FIREMEN may be a new feature at night blazes if a product being tested by the St. Paul fire department becomes standard equipment for the nation's smoke-eaters. Applied to their raincoats, the preparation makes a glow when light is flashed on it in the dark or in smoke filled buildings.

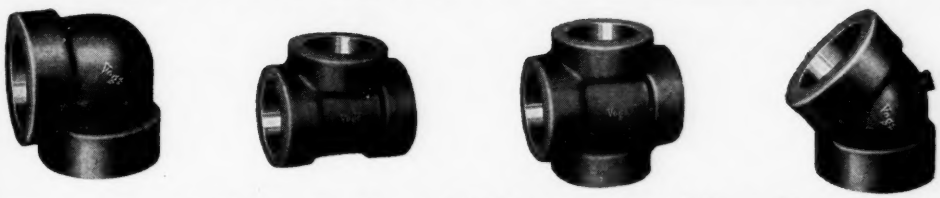
STRENGTH

for Safety and Long-Time Service



For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SCREW END TYPE



For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

SOCKET WELD TYPE

Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-8 will aid you in their selection and proper application.

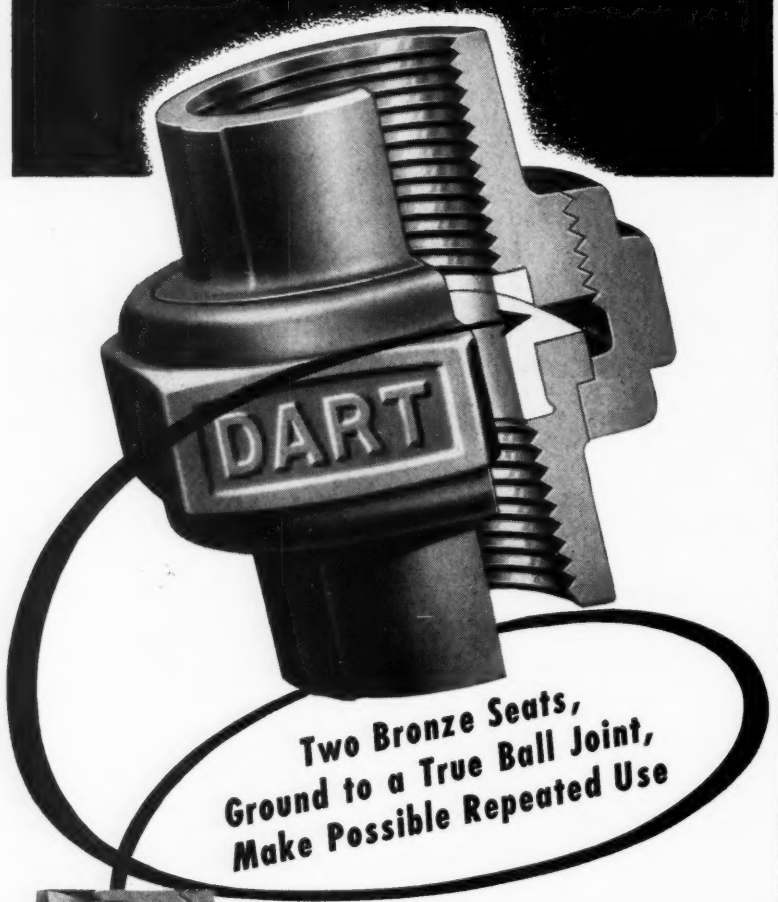
Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.

HENRY VOGT MACHINE CO., INC
Louisville 10, Kentucky
BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

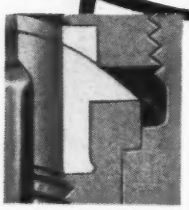
Vogt FOR BETTER FITTINGS

DROP FORGED STEEL FITTINGS

THE SAME DART CAN BE USED OVER AND OVER AGAIN



Two Bronze Seats, Ground to a True Ball Joint, Make Possible Repeated Use



There's true economy in using long-lasting Darts because they can be set to work over and over again in many successive installations. With the two spherical-ground bronze seats forming true bearing surfaces, they close drop-tight without excessive wrenching, jamming, or damage, and open just as readily when needed for use in another location. Body and nut, made of high-test, air-refined malleable iron, are practically indestructible.

You'll find that it pays to standardize on Darts.

E. M. DART MFG. CO.
PROVIDENCE 5, RHODE ISLAND

DART UNIONS

COMING EVENTS

Instrument Society—Instrument Society of America annual meeting; to be held the week of September 8, 1947, with headquarters at the Stevens Hotel, Chicago.

Instrumentation Conference—Instrumentation Conference and Exhibit for 1947, to be held the week of September 8, with headquarters at the Stevens Hotel, Chicago.

AISE—The annual meeting of the Association of Iron and Steel Engineers will be held at Hotel William Penn, Pittsburgh, Pa., on September 22, 23, 24 and 25, 1947.

ASME — Fuels Division Meeting of the American Society of Mechanical Engineers; to be held October 6 through 8, in Houston, Texas. (Headquarters not yet announced.)

Hydraulics—Third Annual Meeting of the National Conference on Industrial Hydraulics (formerly the Hydraulic Machinery Conference); to be held October 16 and 17 in Chicago with headquarters at the Hotel Continental.

ASM—The 29th Annual National Metal Congress and Exposition; to be held in Chicago's International Amphitheatre for seven days beginning Saturday, October 18, 1947.

Industrial Management — Midwestern Conference on Industrial Management; to be held at the University of Missouri, October 23 through 25.

Prime Movers — Fall Meeting of the Prime Movers Committee of the Pennsylvania Electric Association is scheduled for October 23 and 24, 1947, in the Benjamin Franklin Hotel, Philadelphia, Pa.

Water Conference—The 8th Annual Water Conference of the Engineers' Society of Western Pennsylvania will be held in the William Penn Hotel, Pittsburgh, Pa., on November 12, 13, and 14.

Notice—Midwest Engineering and Power Exposition originally scheduled for November 15 through 20 has been cancelled.

ASME—Annual Meeting of the American Society of Mechanical Engineers; to be held in either New York City or Atlantic City, N. J., December 2 through 5. Headquarters Chalfonte-Haddon Hall.

Refrigeration and Air Conditioning Exposition — Fifth All-Industry Exposition; to be held January 26 through 29, 1948, with headquarters at Cleveland Public Auditorium, Cleveland, Ohio.

Obituaries

W. T. JONES

W. T. JONES, Boston, Mass., died of a heart attack on July 19. Born on Peaks Island, Portland, Maine, in 1883, Mr. Jones attended Portland schools and in 1919 was graduated from the Lowell School of the Massachusetts Institute of Technology. Following graduation Mr. Jones entered the drafting room of Whittier Machine Co. He was connected briefly with the B. F. Sturtevant Co., and the Boston Elevated Railway Co., where he was employed in design work. At the Thermograde Valve Co., which he joined in 1912, he became acquainted with William E. Barnes. This association led to the partnership in 1921 of Barnes and Jones, Inc. Mr. Jones was treasurer of the firm at the time of his death.

He was intensely interested in the work of the American Society of Heating and Ventilating Engineers and served as president in 1933, first vice-president in 1932, and second vice-president in 1931. He was also very active in the Massachusetts Chap-

How much is a valve worth?

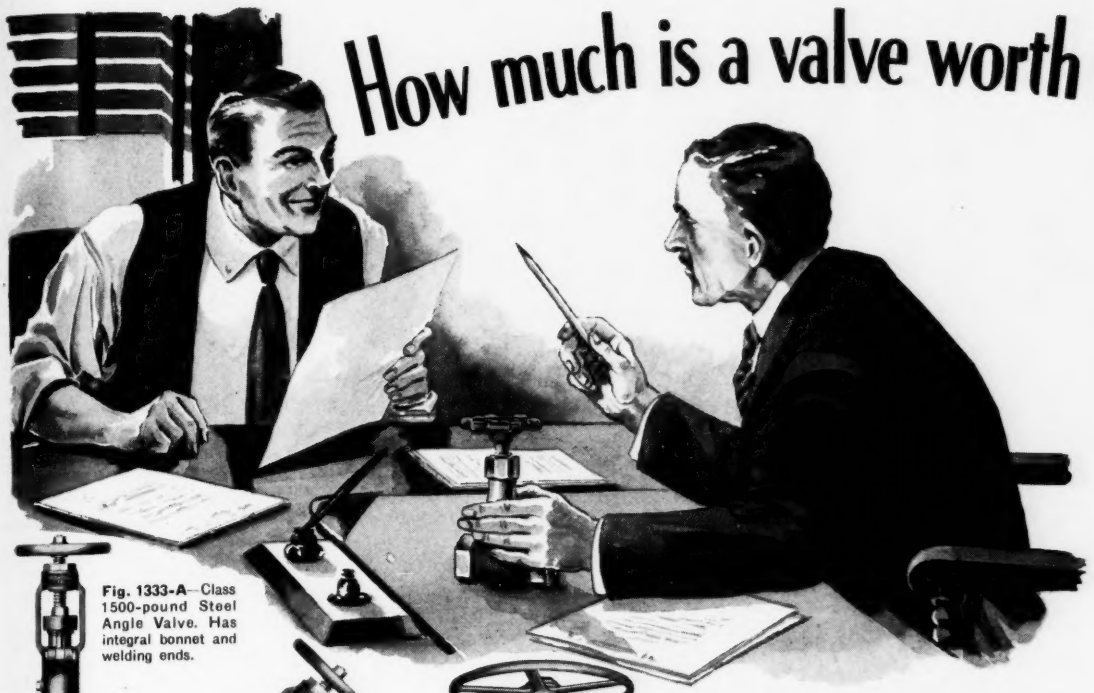


Fig. 1333-A—Class 1500-pound Steel Angle Valve. Has integral bonnet and welding ends.

Fig. 1314-A—Class 1500-pound Steel "Y" Valve. Has integral bonnet and welding ends.

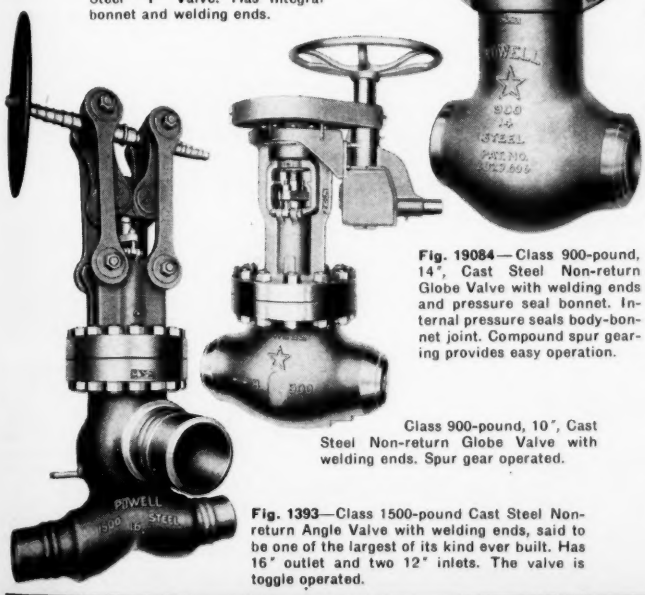


Fig. 19084—Class 900-pound, 14", Cast Steel Non-return Globe Valve with welding ends and pressure seal bonnet. Internal pressure seals body-bonnet joint. Compound spur gearing provides easy operation.

Class 900-pound, 10", Cast Steel Non-return Globe Valve with welding ends. Spur gear operated.

Fig. 1393—Class 1500-pound Cast Steel Non-return Angle Valve with welding ends, said to be one of the largest of its kind ever built. Has 16" outlet and two 12" inlets. The valve is toggle operated.

The $64 question is not "what is the price of the valve," but "how much is it worth?"

And the measure of its worth is "will it do the job, how long will it give satisfactory service, and what will be the ultimate cost of maintenance?" For in addition to the cost of labor and materials in maintaining a valve, don't lose sight of the serious loss in production while a valve is "down" for repairs or replacement.

The Powell Line is so complete* that there's always a Powell Valve specifically adapted to do the job. Powell Valves are noted for long-life, satisfactory service. Powell Valves are designed to reduce maintenance and shut downs to a minimum.

*The Powell Line includes Bronze and Iron Valves of every required type, design, size and pressure; Cast Steel Valves of every type, in pressure classes from 150 to 2500 pounds; and, for the chemical and process industries, a complete line of Corrosion-Resistant Valves in the widest range of pure metals and alloys ever used in making valves.

The Wm. Powell Company
Cincinnati 22, Ohio
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

FULLER
ROTARY
COMPRESSORS

for
SEVERE SERVICE

Fuller Rotaries are built for the hard, severe service all equipment is subjected to today. Thousands of these machines are in service in practically every branch of industry, running 24 hours a day, day in and day out. They're built for just that kind of service ... minimum number of working parts. No valves to leak, no seats to grind, no adjustments or takeup. Of prime importance: *Fullers always maintain original capacity for the life of the machine.*

Get acquainted with Fuller Rotaries ... Send for Bulletin 5-C.

FULLER COMPANY, CATASAUQUA, PA.
Chicago 3 - 120 So. LaSalle St.
San Francisco 4 - 421 Chancery Bldg.

C-149

FULLER
A LIFETIME OF NEW MACHINE EFFICIENCY

ter of the Society and served as its president in 1923 and 1924, and as a member of its board of governors in 1925, 1936 and 1937. As a member of the Society's Council from 1825 to 1930 he served on many of its important committees, including Finance Committee, Committee on Revision of Constitution and By-Laws, serving as chairman of the current committee, the Committee on Research, the F. Paul Anderson Award Committee, and many of the other technical committees.

He is survived by his wife, Mrs. Freida Jones; a daughter, Ruth; a son, Howard; one grandson, his brother and 93-year-old mother.

BERNARD CAREY

BERNARD P. CAREY, fifty-three- vice-president and general counsel of the Philadelphia Electric Co., died recently at his home in Philadelphia.

Mr. Carey was graduated from Temple University in 1913. He was employed the same year by the Philadelphia Electric Co. and became an attorney for it in 1924. Four years later he was promoted to counsel and in 1939 was made general counsel. In 1943 he became a vice-president of the company.

Mr. Carey was a former president of the Pennsylvania Electric Association and the Philadelphia Electric Employees Association. He was a trustee of the Malvern Preparatory School, Philadelphia, and a member of the Pennsylvania Bar Association, the Philadelphia Bar Association, the Union League, the American Gas Association, and the Edison Electric Institute.

Surviving are his wife, Mrs. Catherine Higgins Carey; two sons, Bernard P. Carey Jr., and Arthur Carey, and two daughters, Mrs. Girard Gallagher and Miss Jeanne Carey.

J. CARROLL KENNEDY

J. CARROLL KENNEDY, vice-president of the Kennedy Valve Mfg. Co., Elmira, N. Y., died recently at St. Joseph's Hospital in Elmira, following an operation a few days before. Mr. Kennedy was one of the sons of the founder of the Kennedy Valve Mfg. Co., which was established in New York City in 1877. He had been vice-president in charge of manufacturing for 20 years. He was born in Brooklyn in 1887, and attended Rensselaer Polytechnic Institute.

Mr. Kennedy had served as chairman of several committees of the Manufacturers' Standardization Society, and was a former treasurer of the Industrial Management Association. He had also been active on regional committees of the American Society of Mechanical Engineers.

NEWS *from* THE FIELD

CHICAGO SITE OF AIEE MEETING

DURING the week of November 3-7, Chicago will be the hub of technical activity with the AIEE Midwest General Meeting at the Congress hotel, the National Electronics Conference at the Edgewater Beach hotel, and the Second International Lighting Exposition at the Stevens hotel. As a result of planned co-ordination, a joint session on industrial electronics will be held at the Edgewater Beach hotel, and one on lighting at the Congress hotel.

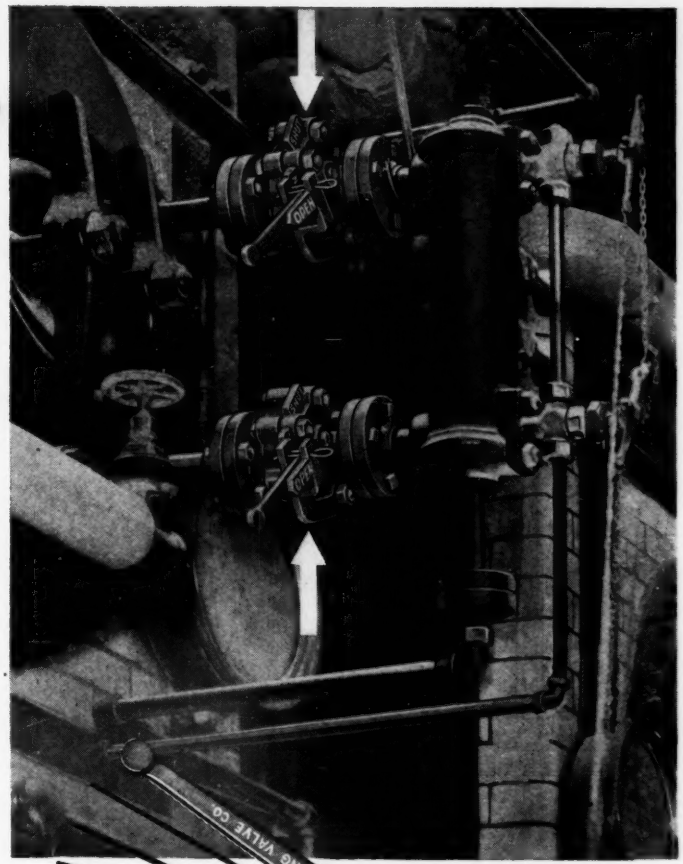
The tentative AIEE program will cover 15 technical sessions, 8 technical conferences, and 3 general meetings. Papers will be presented and discussions conducted on such subjects as power generation, transmission, distribution, communication, electronics, illumination, and new energy sources.

Members are asked to register in advance. This will assist the registration

Install EVERLASTING Water-Column Valves

Before You Need Them

...It's Good Insurance Against Loss!

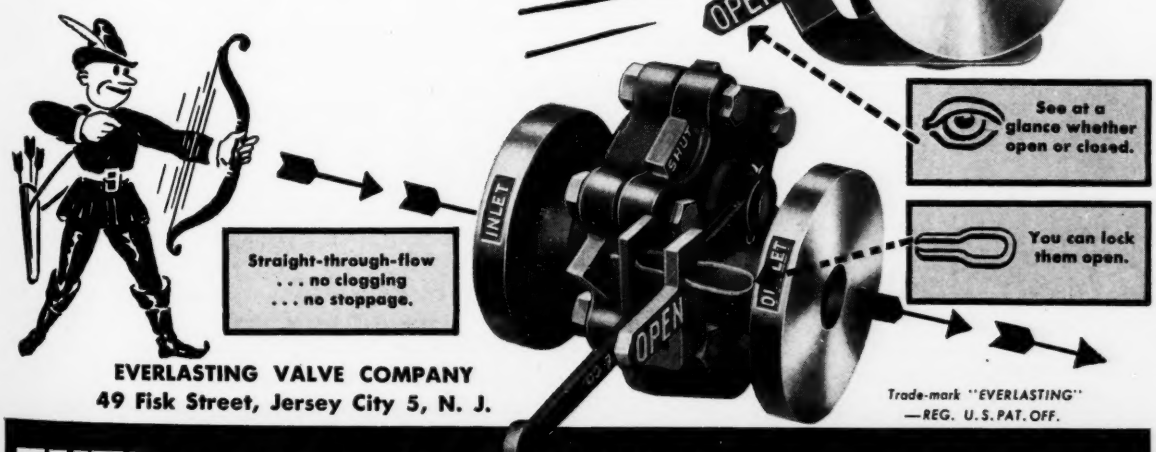


Without effective valve protection at the water-gauge, the breaking of the glass usually compels a boiler shutdown during the emergency. Such breakdowns bring contingent losses all down the line — losses far greater than the moderate cost of EVERLASTING Water-Column Valve protection.

An EVERLASTING installation as shown in the illustration fully meets the A.S.M.E. code in design, construction and performance. These EVERLASTING Valves provide quick-acting lever operation . . . straight-through flow . . . and a drop-tight seal when closed. The straight-through flow prevents valve clogging or stoppage by deposits of sediment. The levers always show at a glance whether the valves are open or closed — and they can be sealed in the open position.

An EVERLASTING Valve on each connection to the water-column is sure and inexpensive protection. But, like all insurance, you must get it *before* you need it — if you are to have the protection when emergency strikes. More than 170 distributors stock EVERLASTING Valves. Ask your distributor or, if you prefer, write us today for complete information.

EV-327

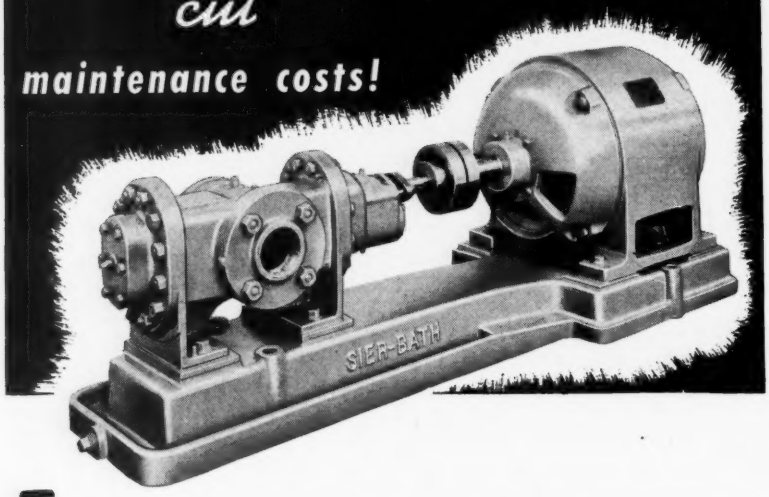


EVERLASTING VALVE COMPANY
49 Fisk Street, Jersey City 5, N. J.

Trade-mark "EVERLASTING"
—REG. U. S. PAT. OFF.

EVERLASTING VALVES *GIVE "EVERLASTING" SERVICE*

SCREW PUMPS built to SIER-BATH accuracy *cut* *maintenance costs!*



The high quality of design and construction of Sier-Bath Screw Pumps enables them to operate continuously for long periods without maintenance. The pulseless flow and vibrationless operation of these pumps greatly reduce maintenance cost—there is less wear on valves, couplings and other fittings. Pipes and joints remain tight and require little attention. With maintenance labor costs at an all-time high, these are important points to consider today in the selection of pumps.

Made in an up-to-date machine shop, accustomed to precision methods and equipped with the most modern machinery, Sier-Bath Screw Pumps always measure up to the highest standards required by users. They are made in both horizontal and vertical models.

Sier-Bath customers are protected from mis-application by the mature pump engineering experience of this Company's staff. Send for descriptive booklet.

ADVANTAGES:
● pulseless flow ● anti-friction bearings ● vibrationless operation
● low maintenance cost ● rugged construction

PUMPS: Acetate, asphalts, brines, Bunker C Fuel Oil, Cellulosics, Greases, Molasses, Syrups, Lube Oils, etc.

FOUNDED 1905 MEMBER A.G.M.A.

★ ALSO MAKERS OF SIER-BATH PRECISION GEARS

Sier-Bath GEAR and PUMP CO., Inc.

9256 HUDSON BLVD. NORTH BERGEN, N. J.

committee and save time on arrival. It is suggested that delegates plan to arrive on Sunday, November 2, as registration starts that afternoon. All members are requested to mention their attendance at the Midwest General Meeting when writing to any Chicago hotel for reservations during that period. Hotels have been notified and will give priority accordingly.

MARSHALL HONORED BY ASME

SECRETARY OF STATE George C. Marshall has been elected to honorary membership in The American Society of Mechanical Engineers, it was announced recently.

In a letter to Eugene W. O'Brien, of Atlanta, Ga., president of the engineering society, Secretary Marshall formally accepted the honor and said that if his other commitments allow, he will attend the annual dinner, to be given on the evening of December 3 in Atlantic City, to accept the award in person.

Henry Ford II, president of the Ford Motor Co., Detroit, will be the speaker at the dinner. His subject has tentatively been announced as: "Greater Production for Peace." The dinner will feature the 68th annual meeting of the society, December 1-5, in Atlantic City, the first one to be held outside of New York.

Three others have been named to receive honorary memberships at that time. They are:

Dr. Harvey N. Davis, president of Stevens Institute of Technology, a past president of the ASME, formerly director of the office of production research and development of the War Production Board.

Francis Hodgkinson of New York, retired consulting engineer, who was connected with the Westinghouse Electric Corp. from 1896 until 1936, a former vice president of the ASME and its Holley Medalist in 1938.

Everett G. Ackart of Wilmington, Del., retired, formerly chief engineer of E. I. du Pont de Nemours and Co., Wilmington.

Lord Dudley Gordon, president of the British Institution of Mechanical Engineers, and noted English authority on refrigeration, received a similar honor earlier this year, in London.

Medals and prizes for 1947, to be conferred at the annual meeting, have been announced as follows:

The ASME Medal, highest honor of the engineering society, to Paul W. Kiefer of New York, chief engineer, motive power and rolling stock, New York Central Railroad.

Holley Medal to Raymond D. Johnson, hydraulic engineer, retired, Fort Lauderdale, Fla.

Worcester Reed Warner Medal to Arpad L. Nadai, consulting engineer, Westinghouse Research Laboratories, East Pittsburgh, Pa.

Melville Prize Medal to Raymond C. Martinelli of the general engineering and construction laboratory, General Electric Co., Schenectady, for an original paper on "Heat Transfer to Molten Metals."

ENGINEERS WANTED

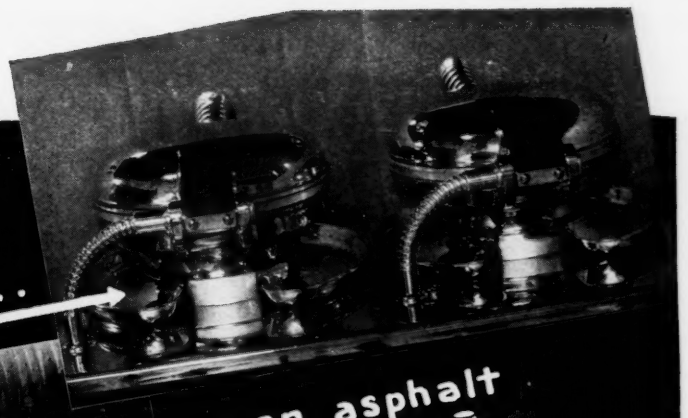
CIVIL, sanitary, electrical, mechanical, refrigeration and air conditioning engineers are needed to fill overseas positions with the U. S. Army Engineers. Positions are available at Guam, Philippine Islands, Okinawa, Japan, Korea and in the Caribbean areas. Salaries range from $3,306 to $8,875 per annum. Housing for dependents is not generally available.

Applications should be made to Civilian Personnel Branch Office of the Chief of Engineers, Building T-7, Gravelly Point, Va. Applications should include completed Form 57, U. S. Civil Service Commission, in duplicate, copies of which can be obtained at your local post office.

NATIONAL ELECTRONICS CONFERENCE

DR. GEORGE D. STODDARD, new president of the University of Illinois and one of

FLEXONICS *at work!*



it's all

REX-TUBE

Flexible metal hose!

Three photos can show only the beginning of uses for Rex-Tube Flexible Metal Hose. And there's a good reason for this wide range utility . . . Standard Rex-Tube is made in *24 different types* of galvanized and stainless steel, brass, aluminum, and other alloys . . . in sizes from 5/32" to 12" inside diameters!

Each Rex-Tube type has been developed to handle certain applications best. CMH leadership in the science of FLEXONICS* provides the knowledge necessary to make Rex-Tube dependable and long-lasting in service, where temperature, pressure, vibration or corrosion conditions are unusually severe.

Write today for CMH Catalog G-47 . . . It gives full details on Rex-Tube — and on other CMH quality products.

*the science of FLEXONICS . . . "the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion" . . . is exemplified in the basic products of Chicago Metal Hose Corporation.

"FLEXON" *identifies CMH products, which have served industry for more than 45 years.*

CMH

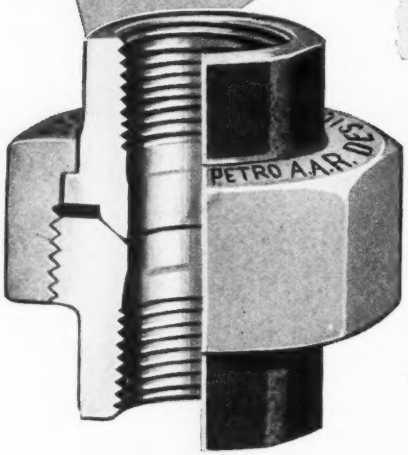
CHICAGO METAL HOSE CORPORATION

Maywood, Illinois • Plants: Maywood and Elgin, Illinois

there is

ENDURANCE

in FORGED STEEL UNIONS



SIZES ⅛" TO 3"

Petro

AMERICA'S MOST UNIVERSALLY USED UNION

PETRO unions have integral steel to steel seats. Made to A. A. R. design. 600 lbs. S.W.P.-2000 lbs. C.W.P. Extra heavy ends and nut with nut threads that are permanently lubricated. The seats are machined and cold rolled.

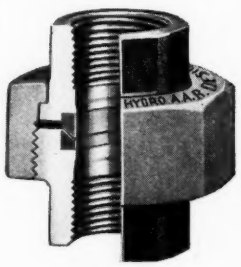
A PARTIAL LIST OF PROVEN SERVICES

Pressures from a vacuum to 3000 lbs.: Temperatures from 100° below zero F. to 1000° above zero F.: On Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and any service in which Steel or Wrought Iron Pipe is Used.

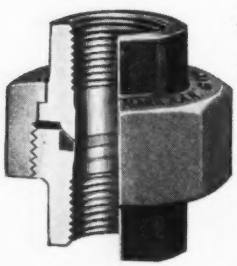
Hydro

THE ONLY FORGED STEEL UNION WITH TWO BRONZE SEATS

Made to A. A. R. design. 600 lbs. S.W.P.-2000 lbs. C. W. P. HYDRO unions have extra heavy ends and nut, with the nut threads permanently lubricated. The bronze seats are completely fused to the steel and are then machined and cold rolled.



SIZES ¼" TO 3"



SIZES ¼" TO 3"

Mark A.A.R.

AMERICA'S FIRST STEEL UNION

The MARK A. A. R. unions have bronze to steel seats. Made to A. A. R. specifications. 600 lbs. S. W. P.-2000 lbs. C. W. P. MARK A. A. R. unions have extra heavy ends and nut with the nut threads permanently lubricated. The bronze seat is completely fused to the steel and then machined and cold rolled.

WRITE FOR PAMPHLET AM-67 • ORDER BY TRADE NAME FROM YOUR JOBBER

ORIGINATORS AND PIONEERS OF FORGED STEEL UNIONS

CLAYTON MARK & COMPANY

1900 DEMPSTER STREET • EVANSTON, ILLINOIS

the nation's foremost educators, will deliver the keynote address at the National Electronic Conference which will be held at the Edgewater Beach hotel, Chicago, on November 3, 4 and 5. Walter Evans, vice-president of Westinghouse Electric Corp., will speak at the Monday luncheon, and Blake D. Hull, president of the American Institute of Electrical Engineers, will be present at the AIEE luncheon on Tuesday. The main banquet will be held Monday night in the Marine dining room, and entertainment will be provided by the stars of the regular Edgewater Beach hotel floor show.

Leon V. Mitelman, 431 S. Dearborn St., Chicago 5, Ill., has announced that he is available for general consulting work in the mechanical engineering field. Mr. Mitelman, a member of the ASME, says that his work will cover power plants, heating, plumbing, ventilating, air conditioning, refrigeration and special problems in engineering and research.

MANUFACTURERS' *News*

CORNING'S NEW DISTRICT OFFICE

THE FORMATION of a Central Sales District, with offices in Chicago, Ill., for the Technical Products Division of Corning Glass Works was announced by the company recently.

John D. Brown, formerly of the industrial sales department, was named manager of the new district. Hugh Harris was appointed to the post of manager of the Chicago office.

SMITH TO MANAGE ENTERPRISE'S N. Y. OFFICE

THE ENTERPRISE ENGINE CO., INC., announces the appointment of C. G. Smith as manager of its New York office at 44 Wall Street, New York City.

Mr. Smith, a graduate of the Webb School of Naval Architecture and Marine Engineering, is widely acquainted in the marine and stationary Diesel engine fields and has considerable experience in the design of power generation and industrial applications.

Herbert Anderson, who has been with the Enterprise organization for a number of years, will continue in his position as assistant district manager of the New York office.

WHEELER ACQUIRES SELLERS' MARINE DIVISION

THE C. H. WHEELER MANUFACTURING CO. of Philadelphia announces the purchase, in its entirety, of the marine division of the Wm. Sellers & Co., Inc., of the same city.

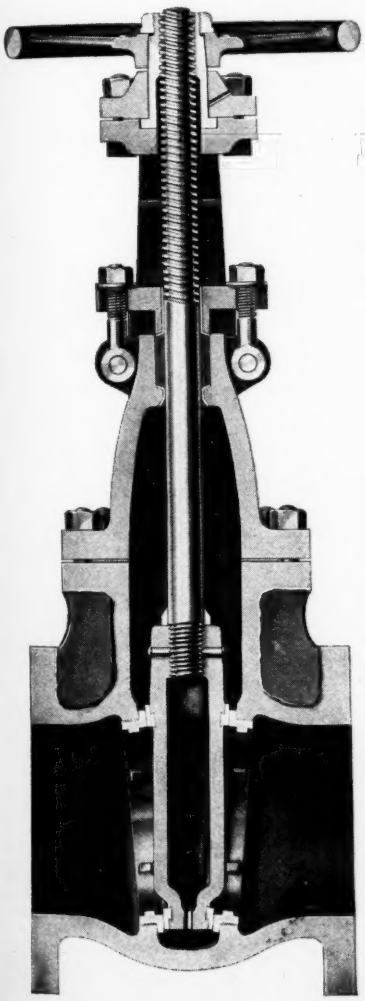
The purchase includes all inventory, engineering and patterns, and this acquisition by the C. H. Wheeler organization will enable them to add the hydraulic, springless, automatic, self-centering Telemotor developed by Sellers to its present

ENTERPRISE ACQUIRES HENDY DIESELS

C. S. HERBERT, executive vice-president of the Enterprise Engine & Foundry Co. of San Francisco, Calif., has announced that the company has acquired the complete line of Hendy marine and stationary Diesel engines formerly manufactured by the Joshua Hendy Iron Works of Sunnyvale, Calif.

Supplementing the extensive line of Enterprise Diesels, the Hendy line of engines will enable Enterprise to expand its manu-

All Four Favor Kennedy



Chief Engineer

"With Kennedy Valves controlling the pipe lines, I know that I won't get any complaints about excessive pressure losses, service interruptions or maintenance expenses due to valves, and no kicks from the men about operating difficulties or frequent time lost due to valve maintenance."

Operating Engineer

"I like Kennedy Valves because they open easily and close tight — and I mean tight. Then, there's never any trouble to connect them on the line, because the screwed ends are accurately threaded and the flanged ends are always true."

Maintenance Man

"You ought to see how quickly I can re-pack a Kennedy Valve, thanks to the many Kennedy stuffing box conveniences. Besides I know I'm safe from emergency calls to fix a Kennedy Valve."

Purchasing Agent

"The Kennedy line helps plant standardization, because I can always find just the right Kennedy type for all our regular requirements in bronze and iron body valves. Their catalog is a honey for completeness and convenience, too."

The large Kennedy line includes gate, globe, angle and check valves, in bronze and iron body, for low, standard, medium and extra-heavy pressures . . . also a complete range of standard bronze and malleable iron screwed fittings, standard cast iron flanged fittings, and standard and extra-heavy cast iron companion flanges . . . all fully described in Catalog 63. Write for your copy today. • *BUY FROM YOUR LOCAL DISTRIBUTOR*

THE KENNEDY VALVE MFG. CO., ELMIRA, NEW YORK

Offices and Warehouses in Principal Cities

KENNEDY

valves–pipe fittings–fire hydrants

End your Carry-over Cares!

...with De-ionized Water for your boiler feed

ILLCO-WAY When solids concentrations are kept low, carry-over is no problem. ILLCO-WAY De-ionizers *remove* dissolved solids, giving you a make-up water comparable to distilled water—but at 1 to 10% of distilled water's cost!—*and with silica removed.*

ILLCO-WAY With this same equipment you prevent boiler scale, corrosion, and embrittlement. ILLCO-WAY De-ionizers will produce thousands of gallons of boiler feed water in your plant and to your most exacting specifications for only a few cents.

ILLCO-WAY Keep your boilers clean, cut maintenance to the absolute minimum by treating make-up water by ion-exchange. Every ILLCO-WAY De-ionizer is backed by years of water-treatment experience. Write for literature describing this method today!

ILLINOIS WATER TREATMENT CO.
850-9 Cedar Street, Rockford, Illinois
7310-PP9 Empire State Bldg., New York

TESTED IN THE LABORATORY
ILLCO-WAY
PROVED IN THE FIELD

Boiler Feed-Water Treatment

Complete equipment for Chemical Processing: Purification of industrial wastes, Separation of Chemical Solutions, Purification of Chemical Solutions, Reclamation of Valuable Constituents

facturing and sales activities into broader fields.

There will be no interruption in the continuity of sales, manufacturing, and servicing of the Hendy engines. The present owners of Hendy Diesels are given every assurance of continued availability of parts and service for all models of the Hendy line.

PORTEUS PRESIDENT STERLING ENGINE CO.

AT A MEETING of the Board of Directors of the Sterling Engine Co., Buffalo, New York, James B. Porteus of Bronxville, N. Y., was elected to the Board and named President of the firm effective immediately.

Mr. Porteus, who succeeds the resigning president, Addison F. Vars, was formerly with the Westinghouse Electric International Co., in charge of distribution in Brazil and subsequently in Northern Latin America.

Mr. Vars was elected Chairman of the Board of Directors effective as of November 1st. He is taking a leave of absence until that date. George M. Ebert continues as executive vice president and comptroller.

BAILEY METER CO. ASSIGNS FIELD ENGINEERS

H. M. HAMMOND, Vice President, Bailey Meter Co., announces that the last members of the 1946-47 Cadet Engineering Class have been assigned to the Company's branch offices. J. H. Wilson reported to Cincinnati early in August and R. W. May will report to New York early in September.

Both of these men are graduate mechanical engineers, Mr. Wilson from Purdue, Mr. May from Clarkson.

Another training course started July 18 with fifteen graduate engineers and one engineering student attending. This course, which lasts approximately six months, will give these engineers a firm groundwork in instrumentation and automatic control as it is applied to power plants and industrial processes.

KIME JOINS RANSOME

RANSOME MACHINERY CO., a subsidiary of Worthington Pump and Machinery Corp., has recently appointed Allan B. Kime as Eastern regional manager in charge of the sale of Ransome Positioning and Turning Roll Equipment.

An electrical engineer, Mr. Kime has had extensive experience in both the production and sales end of the welding field, having been associated for the past twelve years with the Federal Shipbuilding and Drydock Co., Kearny, N. J., in supervisory capacity in charge of welding production methods and procedures. He was formerly sales engineer in the New York metropolitan district for both the Century Electric Co. and the Lincoln Electric Co., and has been a member on the executive committee of the New Jersey section of the American Welding Society.

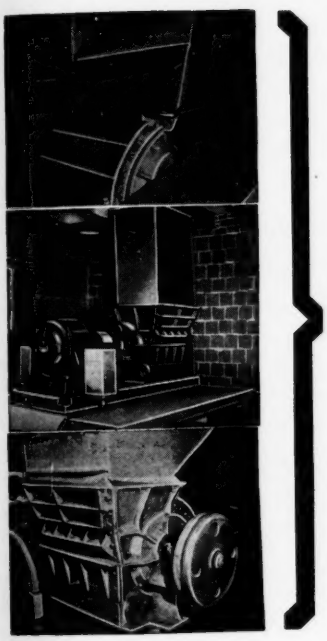
Mr. Kime's Eastern region headquarters will be at the Ransome plant, Dunellen, N. J. He will spend most of his time with Ransome distributors and customers, assisting them in the recommendation and application of Ransome's complete line of welding positioning equipment.

LUDVIK HEADS McALEAR

WILLIAM LUDVIK has returned to the McAlear Manufacturing Co., Chicago, as president and general manager. This announcement is part of one concerning the recent successful negotiations by Mr. Ludvik for the acquisition of the entire stock, plant and equipment of the McAlear Division in Chicago from the Climax Industries, Inc.

In this move to restore the status of McAlear as an independent manufacturer, Mr. Ludvik now heads a company with which he has been identified almost from the time it was founded by the late James

1947 DESIGN FOR MORE EFFICIENT COAL PREPARATION



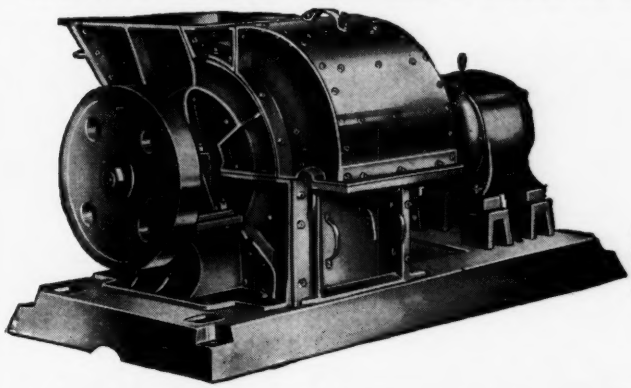
Changing over to Americans is easy because of their minimum headroom requirements and independence from auxiliary equipment.

AMERICAN *Rolling Ring* CRUSHERS

Reduces up to 500 TPH at less than 1c per ton!

With the constant demand for more kilowatt output, getting the most BTU's from each pound of coal is directly related. Here's where coal preparation enters into the efficiency of power production and that's where the American Crushers can improve your efficiency.

The American Rolling Ring Crusher reduces ROM Coal to uniform size for efficient firing.



The basis for greater crushing efficiency is the manganese shredder rings — exclusive with American.

The patented shredder ring action of Americans, through splitting instead of crushing coal results in a uniform product with controlled fines. For stoker feed sizes down to ¼" fines are minimized to the point that subsequent screening is not required to obtain a product that permits a loose firebed that responds to sudden steam demands—admits oxygen for efficient burning and yet does not have excessive ashpit drop.

The fineness to which Americans will grind pulverizer sizes without oversize reduces the load on the ball grinders and increases preparation efficiency in pulverizer feed operations.

The American bulletin "Crushing Coal for Less Than 1c Per Ton" is yours for the asking. Write for it.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1429 MACKLIND AVE.
ST. LOUIS 10, MO.

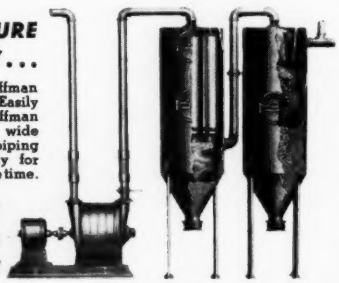
HOFFMAN VACUUM CLEANING

You completely wipe out dangerous "derelict dust" with Hoffman equipment for vacuum cleaning. Provides quick, convenient and thorough clean-up of floors, walls, overhead areas to rout fire and explosion hazards, to protect workers' health and machine life—and to save fuel and increase production.

WRITE FOR LITERATURE AND A FREE SURVEY...

Left—one of the four sizes of Hoffman portable vacuum cleaning units. Easily handled by one man. *Right*—Hoffman makes stationary systems, in a wide range of sizes, with permanent piping and multiple-sweeper capacity for cleaning several locations at same time.

HOFFMAN SPECIALIZES IN VACUUM CLEANING SYSTEMS FOR INDUSTRY



U. S. HOFFMAN MACHINERY CORPORATION

AIR APPLIANCE DIVISION, 101 FOURTH AVE., NEW YORK 3, N. Y.

A. McAlear nearly 30 years ago. For several years prior to 1943, when the organization became a division of the Climax Corp., he was vice-president and manager of the McAlear Mfg. Co.

IRON FIREMAN FINANCING

AN ARRANGEMENT between the Iron Fireman Manufacturing Co. of Cleveland, O., and Portland, Ore., and the Commercial Credit Corp. of Baltimore, Md., which provides the wholesale financing of Iron Fireman products has been announced.

The financing agreement has been made to assist any of the 2,000 dealers handling Iron Fireman products who might wish to use it to advantage in increasing the sales of coal stokers, oil burners, gas burners, self-firing furnaces and boilers, and other equipment. Last year, although greatly handicapped by the material shortages which plagued the nation's manufacturers generally, Iron Fireman's sales were over $11,500,000, its greatest peacetime volume. With the company's recent entry into the oil burner and allied heating trade fields, it is believed that the 1946 volume will be greatly exceeded during the current year.

SUN OIL COMPLETES NEW PLANT

COMPLETION of a $200,000 pressure-maintenance plant to conserve crude oil in the Norwich Field, Missaukee County, Mich., was announced recently by James E. Pew, manager of the natural gas and natural gasoline division of Sun Oil Co.

The plant was constructed as part of a $4,000,000 oil and gas conservation program launched by the company in the spring of 1946. Nine processing plants are contemplated under the program.

Natural gas produced along with crude oil in the Norwich Field is being collected and piped to the new plant, where it is compressed to more than 2000 psi and returned to the producing formation to assure maximum recovery of the underground oil reserves. The plant is designed to handle 3,500,00 cu ft of gas per day.

SINGH COMPANY FORMED IN CHICAGO

A. D. SINGH announces that the Singh Co. was formed in May, 1947, to serve industry, state, municipal and federal agencies in the field of research, engineering development, in process development, plant design, installation and operation. It is chartered under the laws of the State of Illinois and its headquarters are at 20 North Wacker Drive, Chicago 6, Ill.

Mr. Singh, president of the company, states that at present the company's work will be focussed on problems in which he has had several years of personal experience. These include development of gas cleaning processes, chemical production processes under pressure and at high temperatures, air pollution studies, processing of coal for smokeless fuel, gaseous fuels and tars.

Mr. Singh aided John I. Yellott in the development of the flash pulverizer for various materials, including coal. As the coal atomizer, it is included in the currently developing coal-burning gas turbine locomotive.

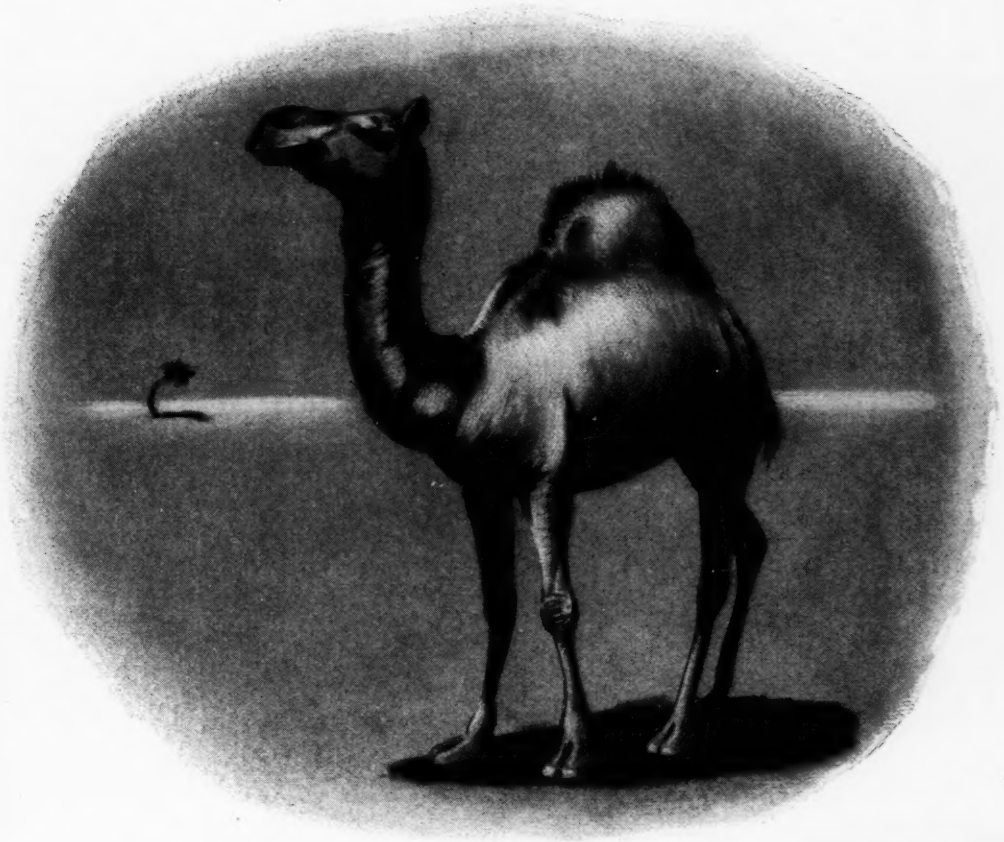
For several years past, Mr. Singh has been research engineer in the Institute of Gas Technology, Chicago, Illinois, and in charge of the institute's coal gasification section.

LINK-BELT ANNOUNCES PROMOTIONS

FOLLOWING CLOSELY on the heels of other recent announcements of promotions in the Pershing Road plant, Chicago organization of Link-Belt Co., are these additional promotions:

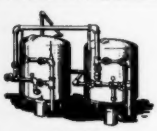
Ralph W. Rausch, who has been assistant chief engineer at the Pershing Road plant, in charge of estimate-engineering

(Continued on page 190)

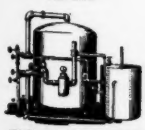


DROMEDARIES DON'T WORRY ABOUT DEAERATION

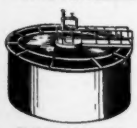
HOT PROCESS SOFTENERS



FILTERS



ZEOLITE SOFTENERS



REACTIVATORS

Dromedaries, in fact, have practically no problems where water is concerned. Deaeration certainly bothers them not at all.

Deaeration, however, is a major factor in the conditioning of boiler feed water for corrosive gases such as oxygen and CO_2 which remain in the water after softening, must be removed. Deaeration of both the conditioned water and the condensate returns is a necessity.

Deaeration can best be accomplished in conjunction with the softening process, or within the softening equipment. The Graver hot process softener, with heating and deaerating facilities built-in, offers complete boiler feed conditioning . . . equally effective at extremely low flow and at maximum capacity.

It's to your advantage to find out more about this and other Graver equipment that means complete protection for your boiler system.

GRAVER TANK & MFG. CO., INC.

General Offices: East Chicago, Indiana
New York Philadelphia Chicago

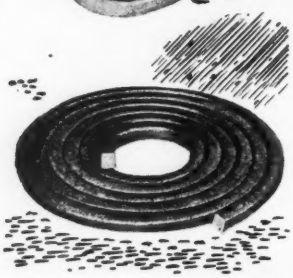
Water Conditioning and Process Equipment Division

GRAVER

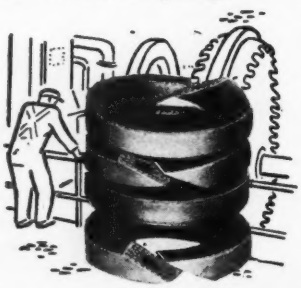
BELMONT
PACKINGS
solve sealing problems

These three packings are representative of the extra values built into each product in the complete Belmont line. For every service . . . steam, water, oil, gas, acids, alkalis, ammonia . . . your Belmont Distributor has the right packing.

BELMONT #30 For High Pressure Steam Rods and Expansion Joints. Center block pleated on itself (accordion fashion) at approx. 90° angle with rod, affording, high resiliency and flexibility, extra take-up, extra "edge wear" if packing wears toward the rod.



BELMONT #189 For Hot Oil Rods and Plungers. Has extra resistance to penetration. Long-fibre asbestos yarn is firmly braided, each strand treated with a special compound so that saturation and penetration are minimized.



BELMONT #19 Hollow Center Packing For Intermediate and Low Pressure Steam; Hot and Cold Water Rods and Plungers. Hollow Center permits expansion and contraction. Packing "breathes" toward the hole, so friction is kept at minimum point created by the working pressure itself.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

Belmont Packings are available in every large industrial center, through Belmont Distributors.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia

Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

HELPFUL BULLETINS

(Continued from page 42)

last page of the folder tells the types of equipment that can be cleaned by this chemical and another listing gives the specifications of the material. Pennsylvania Salt Mfg. Co.

MISCELLANEOUS

43 **Chemical and Process Equipment**—Described in this 8-page bulletin are special processing equipment, kettles and autoclaves, tanks and pressure vessels, heat exchange equipment and distillation equipment. Examples of each type of product are pictured and a brief description accompanies the photo. The Patterson-Kelley Co., Inc.

44 **Cooling Water Treatment**—Bulletin 10 is an engineering information sheet on the treatment of cooling water. A brief explanation of the reaction which takes place in heat exchangers, condensers, engine jackets, etc., is presented and the bulletin then goes on to describe the necessary treatments for various desired results. Liquid Conditioning Corp.

45 **Insulating Material**—High temperature insulation is described in this 4-page bulletin. Called "Refrasil," this insulation is described as a new high silica content, all mineral insulation. The bulletin points out that insulation is available in batts, cloths, tapes and sleevings, cordage, loose fiber and in prefabricated blankets. Properties of the batt and cloth type Refrasil are given in the bulletin and a listing of some of the uses in industry is given. The H. I. Thompson Co.

46 **Electrical Precipitation**—The Cottrell Process of electrical precipitation is completely described in this recently-issued 28-page bulletin. The description is logically developed from the description of the three gas cleaning problems—recovering material of value, cleaning for subsequent use, preventing a nuisance—up to an excellent set of photographs showing various uses of the Cottrell Precipitator throughout industry. "How the Cottrell Electrical Precipitator Works" is a brief 2-page description, with diagrams, of the basic principles involved. Descriptions of advantages follows. Research Corp.

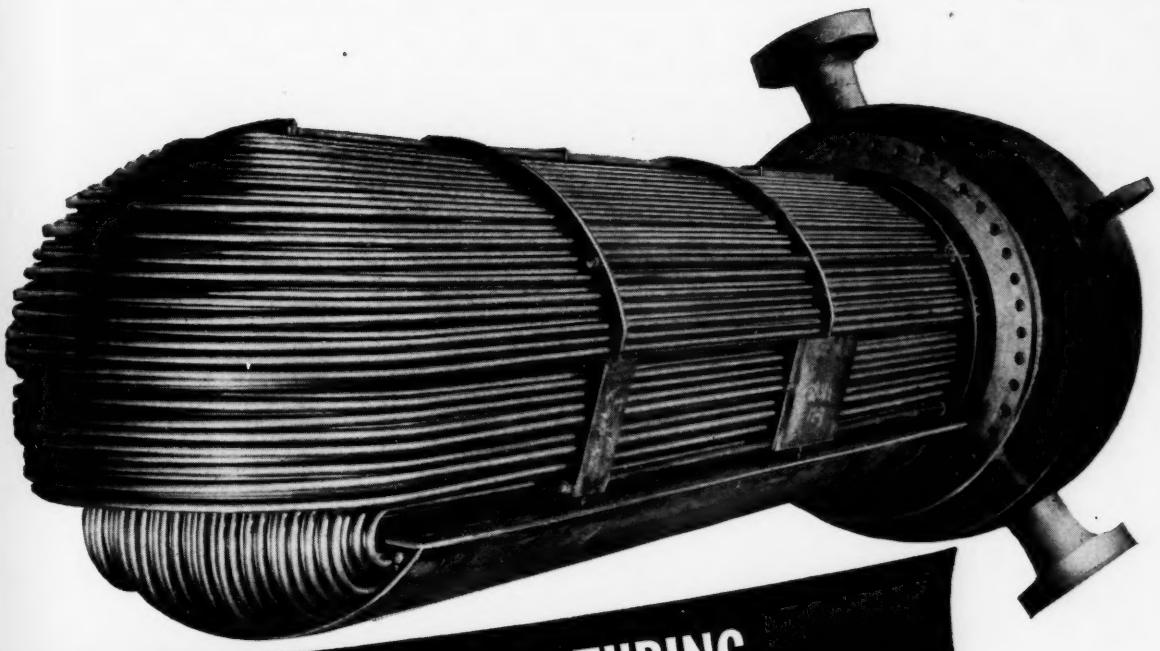
47 **Welding Fittings**—Stainless steel welding fittings are described in recently-issued Bulletin 47-1. The fittings described are 90 deg elbows, 45 deg elbows, 180 deg returns, lap-joint stub ends, tees, caps, reducers. Specifications for each type of fitting are presented and tables give complete dimensional information. Photos of fabricated piping and coils are given. The last page in the bulletin presents information on the welding of stainless steels. Midwest Piping & Supply Co., Inc.

48 **Industrial Heater**—Bulletin 516 describes this new heater designed for industrial and commercial use. The bulletin outlines in detail the application of stainless steel to combustion chambers. The center spread of the bulletin gives 18 advantages of the unit such as the heat resisting quality of the stainless steel combustion chamber, proper safety control of the unit, the adjustable damper which controls the draft and circulation of air in summer. All these features are pointed out on a cutaway drawing of the unit. Dravo Corp.

49 **Sewage Disposal, Water Works**—Bulletin 23-120-B10 is an 8-page booklet covering various types of equipment for use in sewage disposal plants and water works. This bulletin shows numerous rotary, positive and centrifugal installations in typical sewage disposal plants. A brief description of the installation accompanies each of the illustrations and indicates the capacity and pressure of the blowers shown. Diversity of driving arrangements are also covered. It points out how the blowers can be driven by any type of standard drive that best suits the customers' requirements. Roots - Connersville Blower Corp.

50 **High Side Floats**—This company's inverted bucket high side floats for discharging liquid refrigerant to the low side of refrigerating systems are described in Bulletin 178. Cutaway views of the float show five stages of operation from the time the liquid enters at the bottom to the point where nearly filled with liquid the bucket weight is sufficient to pull the valve from the set. Armstrong Machine Works.

XUM



0.065" WALL TUBING HANDLES FEEDWATER AT 1300 P.S.I.

Here's another example of how Monel* helps solve the problems created by soaring temperatures and pressures in modern power plants...

Griscom-Russell Company's Massillon, Ohio plant built this new final-stage preheater for a tube working pressure of 2000 p.s.i., using No. 16 B.W.G. (0.065" wall) annealed Monel tubing of 3/4 inch outside diameter.

This thin-walled, corrosion-resistant Monel tubing permits preheating 439,000 pounds of feedwater per hour, from 345° to 410° F., with steam bled into the shell at 675° F. Boiler operates at 915° F. and 1225 p.s.i.

Strength of Monel greatly exceeds that of other non-ferrous tubing materials, thus permitting thinner tube walls and larger inside diameters. Result is good heat transfer with minimum pressure drop.

Even at elevated temperatures, Monel resists corrosion and offers a smooth, clean surface that retards formation of heat-obstructing jackets of scale and deposits.

In addition, Monel's hardness resists erosive wear, and its ductility allows expanding the tubes into snug-fitting, durable connections with the head.

The extraction heater above... actually a repeat order from the Narragansett Electric Company, Providence, R. I.... confirms the high efficiency of a similar Monel-tubed unit serving their Manchester Street Station since 1941.

• • •

Other installations of Monel tubing in high-pressure power stations:

At the Twin Branch plant of Indiana and Michigan Electric Company, subsidiary of the American Gas and Electric Service Corp., Monel tubing was installed in a preheater handling 550,000 pounds of water an hour at 3200 pounds pressure per square inch—under external temperature of 637° F.—feeding a boiler operating at 2500 pounds steam pressure!

In the Oswego plant of the Central New York Power Corp., Monel heater tubing was installed to operate under 2000 pounds water pressure, at an outside temperature of 770° Fahrenheit.

If you have problems involving metals for equipment now in production or planned, consult INCO Technical service... make use of the wide experience of our engineering staff. Write:

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall Street, New York 5, N.Y.*

EMBLEM OF SERVICE

NICKEL INCO TRADE MARK **ALLOYS**

MONEL • "K"* MONEL • "S"* MONEL • "R"* MONEL • "KR"* MONEL • INCONEL* • NICKEL • "L"* NICKEL • "Z"* NICKEL

*Reg. U.S. Pat. Off.

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions dictated by space requirement or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

BOILERS

51 **Steam Generators**—Catalog almost completely devoted to cross-sectional drawings with accompanying listing of principal data of typical installations in rubber companies, steel works, sugar refineries, municipal plants, etc. Details of furnace water wall construction on inside back cover; 16 pages. Henry Vogt Machine Co., Inc.

52 **Double-Pass Boilers**—Bulletin R-M-1 (6th edition); illustrates and describes this line of riveted or welded double-pass steel firebox boilers. Three full pages of dimensions, ratings and other details including dimensioned line diagrams; 8 pages. The Brownell Co.

53 **Boilers, Burners, Accessories**—Bulletin GC-10; condensed catalog of regular products for stationary power plants. Each class of equipment summarized and illustrated with line drawings and photographs. Illustrations accompanied by brief descriptions; 12 pages. Combustion Engineering Co., Inc.

54 **Standardized Boilers**—Bulletin 746; 4 page bulletin presenting construction and operation information and ordering specifications for this company's Type M boilers. Bulletin illustrated, presents table of measurement and data. Springfield Boiler Co.

55 **Steam Generators**—Presents reasons for high efficiency; shows brief case histories of plants. Results of tests by independent authorities and "Facts You Should Know About Steam Generating Unit." Ratings, dimensions and other data presented. Springfield Boiler Co.

56 **Steam Generator**—Bulletin 119; company's Type S steam generator described and features of construction are pointed out. Folder well illustrated and dimensioned drawing and table of dimensions and sizes are given. Union Iron Works.

PRIME MOVERS

57 **Axial Flow Impulse Turbine**—Bulletin S-107; six types described; data for estimates; applications; types, casings; wheels and blades; shafts, nozzles and bearings; overspeed stop and other governor features; lubrication; 8 pages. The Terry Steam Turbine Co.

58 **Multi-Stage Turbine**—Bulletin SR-114; Casing, lagging, wheels and blades; shafts, nozzles, bearings; governors; speed changer or synchronizer; governor valve and steam strainer; lubrication; general; 10 pages. The Terry Steam Turbine Co.

59 **Turbines, Pumps, Products**—This 24-page catalog covers the company's complete line of products from steam turbines to flexible couplings. Every product is discussed from the design and operation angles and the discussion is heightened in interest by the inclusion of many excellent photographs. Other products discussed are helical gears, centrifugal pumps, multi-stage pumps, screw pumps, blowers, compressors and speed reducers. De Laval Steam Turbine Co.

60 **Turbine Cleaning Manual**—This 20-page bulletin covers the step-by-step solvent and manual cleaning of turbines from the inspection and preliminary cleaning to draining and final inspection. The cleaning of bearings and governor, installation of filter unit, circulation of cleaning solvent, and displacement of cleaning oil with new lubricating oil are steps which are covered briefly but clearly. Shell Oil Company, Inc.

61 **Steam Engines**—Bulletin No. 306; Engineering data; tabular material, descriptions; 8 pages. Troy Engine & Machine Co.

62 **Generating Sets**—Bulletin No. 108; General description, typical installations, engineering data tables, details of construction, completely illustrated; 24 pages. Troy Engine & Machine Co.

63 **Stationary Diesel Engines**—Dependability, adaptability of Diesel power described and applications pointed out. Its economical and simple design is stressed. Advantages of company's equipment brought out; exceptionally well illustrated; 24 pages. Enterprise Engine and Foundry Co.

ELECTRICAL

64 **Oil Circuit Breaker**—Bulletin 71B-6421 describes Unitop oil circuit breaker; ratings from 15 to 46 kv, 500,000 to 1,500,000 kva interrupting capacity. Well illustrated, Allis-Chalmers Mfg Co.

65 **Generating, Substation Equipment**—Bulletin 25B6150 titled "More Power to U.S.A." 32 pages; sketches coverage of the company's equipment from hydro and steam turbines to switchgear and circuit breakers. Unusually well illustrated. Allis-Chalmers Mfg. Co.

AUXILIARIES, ACCESSORIES

66 **Strainers and Separators**—Bulletin 46-50; describes complete line of company's strainers and separators. Dimensioned drawings and photographs; tables of sizes and complete description of applications, operation and design; 16 pages. American District Steam Co.

67 **Atomizing Deaerators**—Bulletin 4160; 3 color drawing illustrates description of principle of operation. Advantages of deaerators are described and illustrated; marine deaerators also covered; 20 pages. Cochrane Corp.

68 **Condensate Return System**—Description of operation and possible savings accompanied by line diagram and description of how "Jet-Loop" works; typical installation pictured and described. Drawings and text show proven results from

What...NO WEEKLY CLEANING?"

Weekly tube cleaning went out with horse-drawn cars and mustache cups. Today's boiler designs and feedwater treatment have improved greatly. Tubes don't scale up as fast. But when scale *does* accumulate, it presents a bigger problem than ever before—bigger because boiler temperatures and pressures are higher—tube failures can be more disastrous. Bigger, too, because boiler down-time and repair-time are increasingly expensive in view of today's rising costs.

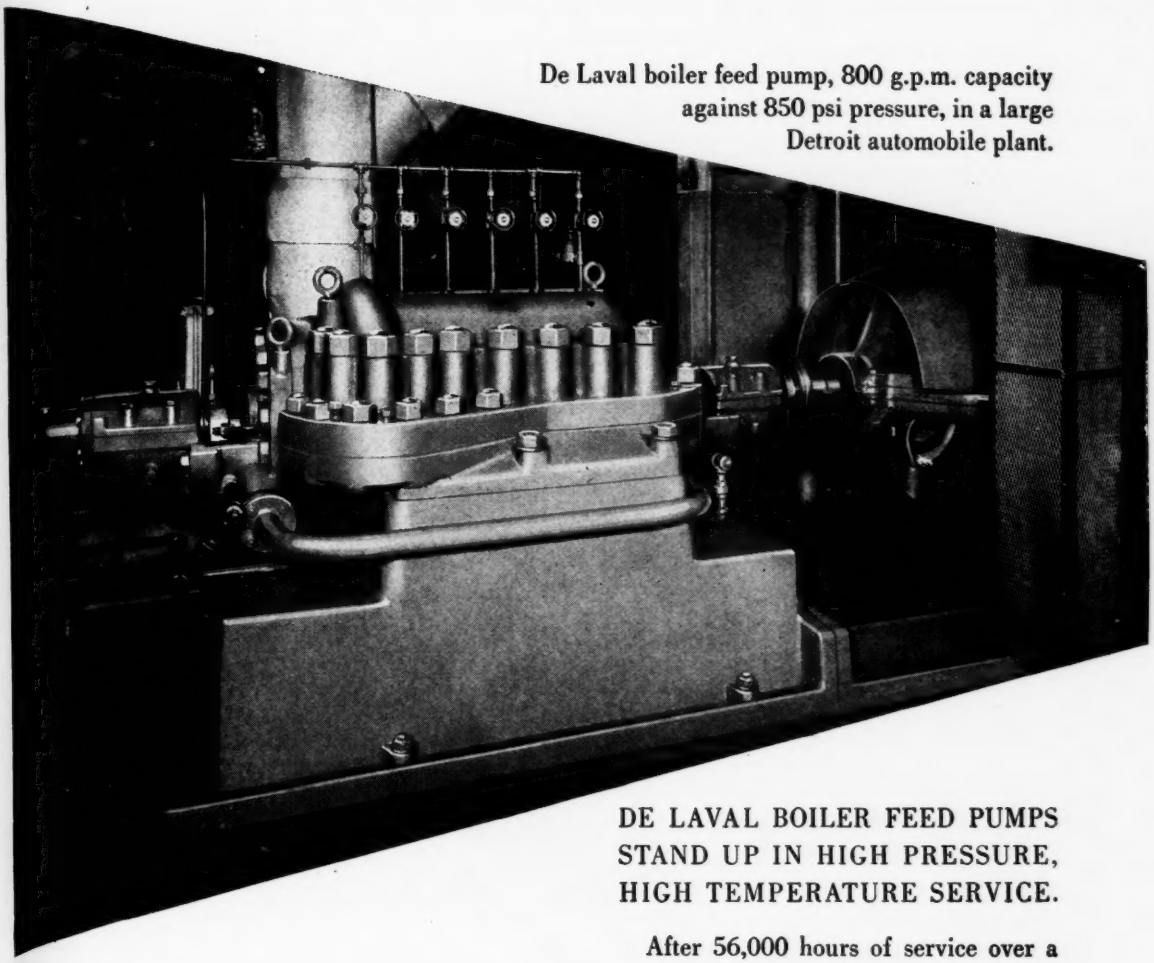
That's why fast acting Wilson Tube Cleaners are found in more and more modern boiler plants. The Wilson ECT Series Air Motor, for instance, develops up to 40% more power when "taking the curves", permitting substantial reductions in cleaning time. This motor, together with the patented Wilson Expanding Brush, will remove the light powdery deposits found in today's boilers *faster* and *more thoroughly* than any other cleaner. When heavier deposits are found, speedy non-tracking Wilson Cutter Heads are available.

Every modern boiler plant should have fast Wilson Tube Cleaners in the tool room. Why not write for Bulletin 47 describing the more generally used Wilson Cleaners, or see your local Wilson Representative?

THOMAS C. WILSON, INC. • 21-11 44th Avenue, Long Island City 1, N. Y.
Cable address: "TUBECLEAN", New York

WILSON
TUBE CLEANERS

TW-732



De Laval boiler feed pump, 800 g.p.m. capacity against 850 psi pressure, in a large Detroit automobile plant.

"IN EXCELLENT CONDITION after 56,000 hours"

reports inspector

DE LAVAL BOILER FEED PUMPS STAND UP IN HIGH PRESSURE, HIGH TEMPERATURE SERVICE.

After 56,000 hours of service over a period of nine years, the power plant superintendent of a large Detroit automobile manufacturer asked for an inspection of this pump. The inspection was made and the following report received.

"We completely disassembled the pump and found wheels, diaphragms, shaft, bearings and all other parts in excellent condition. There was no washing of the pump case or any kind of corrosion. The shaft sleeve was highly polished. Balance parts including labyrinth leak off and the leak off bushing over the discharge end of the shaft sleeve hubs had but .005" wear."

In every detail De Laval pumps are designed for long trouble-free service.

DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

Atlanta • Philadelphia • Charlotte • Pittsburgh
Cleveland • Rochester • Detroit • San Francisco
Chicago • New York • Denver • Kansas City
Helena • Boston • Houston • Washington, D. C.
St. Paul • Los Angeles • New Orleans • Seattle
Salt Lake City • Tulsa • Edmonton • Winnipeg
Toronto • Vancouver

DE LAVAL

BF-4

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

experience of users. 2 page spread of drawings and table of dimensions; 16 pages. Cochrane Corp.

69 **Low Pressure Evaporators**—Description of L. P. evaporators; types of evaporator plants, listing of advantages of L. P. submerged tube evaporators. Line diagrams illustrate principles brought out in descriptions. Typical installations are considered and analyzed; 12 pages. Condenser Service and Engineering Co., Inc.

70 **Power and Industrial Equipment**—Bulletin Q-12; describes and illustrates company's equipment for power and industrial use—steam turbines, motors, generators, feedwater heaters, turbo-chargers, steam jet ejectors, centrifugal blowers. Exceptionally well illustrated; 20 pages. Elliott Co.

71 **Heat Exchanger**—This new bulletin describes the company's Twin G-Fin Section; Bulletin 1614; section characterized as universal heat exchanger. Bulletin tabulates 21 features and corresponding advantages, describes design and construction. Installation views shown, field reports included; 16 pages. The Griscom-Russell Co.

72 **Evaporators**—Bulletin 364 describes, illustrates exporators for various capacities and pressures; contains sections of special interest to plant engineers and executives; includes explanation of functions of evaporators, benefits obtained by their use; different types of evaporating systems and their association with plant balance. 26 pages. The Griscom-Russell Co.

73 **Soot Blowers**—Bulletin F15; soot blowers in general are described. Description and operation of units, materials and specifications and other pertinent information is presented; tables of steam consumption, boiler efficiency, fuel saving chart; boiler cross-sections with blower locations indicated thereon and installation drawings and data are included; 10 pages. Marion Machine, Foundry & Supply Co.

74 **Water Heater Capacity Ratings**—14 tables are included in this ratings booklet showing capacity ratings per hour for temperature rises of from 20 deg (50 to 70 deg) up to and including ratings for a 150 F temperature rise (50 to 200 F). Table No. 15 presents the rate of flow of steam through pipes with steam from an initial gage pressure of one pound up to 150 psi. Marion Machine, Foundry and Supply Co.

75 **HP Extraction Heater**—Bulletin M-302 describes and illustrates the company's patented high pressures closure, Multilok. The features and advantages of the closure as compared to other types of construction are fully described in this 8 page bulletin. The Lummus Co.

76 **Coal Weighing Scales**—Description; outstanding features, specifications, line drawings, photos; 4 pages. Beaumont Birch Co.

77 **Rack and Pinion Gates for Coal and Ashes**—Ball-bearing, dust-tight features; photos, specifications, drawings, tables of dimensions; 4 pages. Beaumont Birch Co.

78 **Steam Specialties**—Collection of folders; steam trap, air trap, reducing valves, classes E, B and H pump governors, automatic boiler feedwater controller; parts and units list prices; descriptions; illustrations; tables of capacities. The C. E. Squires Co.

79 **Deaeration**—Data book; No. N-15 gives reasons for and principles of deaeration; cold water deaeration; tabular drawing and chart material presented; well illustrated; 20 pages. Elliott Co.

80 **How to Choose a Steam Trap**—Trap selection, trap rating, trap capacity factors, individual trapping, determining lift; traps for unit heaters, pipe coils, fan system heating surfaces, steam jacketed kettles, autoclaves, laundry equipment, paper makers, etc.; installation, operation, maintenance, instructions; specifications and capacities, corrosive service; 42 pages. The V. D. Anderson Co.

WATER TREATMENT

81 **Index for Calcium Carbonate**—Reprint of paper by John W. Ryznar; tables and charts; 16 pages. National Aluminate Corp.

82 **Boiler Feedwater Q & A**—Bulletin 30; 102 questions and answers on various problems of boiler feedwater; 16 pages. National Aluminate Corp.

83 **Water Treatment**—Scale and corrosion control in potable water supply; reprinted paper presented by Hanlon, Steffen, Rohlich and Kessler; 12 pages. National Aluminate Corp.

84 **Water Conditioning Service**—"The 6 Fundamentals of Betz Water Conditioning Service" illustrates and describes how this company extends a supervisory service for boiler water conditioning. Booklet shows complete operation of these 6 steps; 16 pages. W. H. & L. D. Betz.

85 **Water Softener**—Bulletin 607; benefits and economies of soft water; typical applications; how it works; types; design and features; backwash and brine rinse regulators; how to modernize present softener; aerators, degasitors, chemical feed systems, chemicals; 20 pages. Elgin Softener Corp.

86 **Softener Handbook**—Manuel, semi and full-automatic zeolite water softeners are covered in Bulletin 315. Water softener plant is discussed in the first section and operating cycles and plant supervision is next considered. The third section is "Selecting Manual or Automatic Equipment"; this is accompanied by a table of comparison data. Graver Tank & Mfg. Co., Inc.

87 **Sludge Reactivator**—Illustrated booklet, 8 pages, fully explains the principle of upward sludge filtration and describes its adaptability to industrial and municipal water supplies. Charts, flow diagrams and cut-away drawings show clearly how equipment softens and clarifies raw water, materially reduces reaction time and provides, in many cases, a water that is suitable for process work without further treatment. Graver Tank & Mfg. Co., Inc.

88 **Hot Process Water Treatment**—Form 326 is a case study bulletin; covers results of an installation of the company's hot process equipment at Kankakee Ordnance Plant. System was designed to provide 60,000 gph of properly conditioned water, free from hardness, scale forming minerals and corrosive gases. Graver Tank & Mfg. Co., Inc.

89 **Water Treatment**—Control of Fouling Organisms in Fresh and Salt Water, by John G. Dobson. Life history of these organisms; method of control. Wallace & Tiernan Products, Inc.

90 **Industrial Water Treatment**—Microbiological Control of and Through

Day and night cowboy for $1 a month!

Stock farmers cheer loud and long for electrically charged fences.

This electric cowhand keeps herds in pasture 24 hours a day. And the cost for power? It's probably less than a dollar a month.

And this is only one of many blessings that electricity has brought to rural areas.

Abundant electric power at a reasonable price is no overnight phenomenon. It's the result of careful, long range planning by a farsighted industry—with a major thought always to wider distribution and greater production efficiency.

During long and close association with the industry, American Blower has worked with producers of power to constantly increase plant efficiency.

American Blower manufactures three groups of power plant products: Mechanical Draft Fans, Fly Ash Precipitators and Gyrol Fluid Drives—the popular method for adjustable speed control of mechanical draft fans and boiler feed pumps.

Perhaps you use these products now or know them by reputation. In any event, you will find each makes a contribution to greater overall plant efficiency—in a new plant or in plant modernization.

Why not contact the nearest American Blower Branch Office now? An engineer, trained to serve your needs is ready to give you full benefit of American Blower's experience and facilities.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICH.
In Canada: CANADIAN SIROCCO CO., LTD., WINDSOR, ONT.

AMERICAN BLOWER

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

4 books on products to improve overall power plant operation

Gyrol Fluid Drive for Boiler Feed Pumps—Bulletin No. 8019

Gyrol Fluid Drive for Mechanical Draft Fans—Bulletin No. 7019

Fly Ash Precipitators (Series 361) Bulletin No. 1628

American HS Forced Draft Fans Bulletin No. A-703

XUM

Industrial Waters; spot summaries of improvement of process efficiency and product quality of proper sterilization. Wallace and Tiernan Products, Inc.

91 **Condenser Water Treatment**—Chlorination of Condenser Cooling Water, by R. B. Martin; important consideration in chemical treatment of cooling water circuits. Wallace & Tiernan Products, Inc.

92 **Water Treatment**—Chlorine Destroys Ammonia, by A. E. Griffin. Gives data on use of chlorine for elimination of ammonia from boiler feed water. Wallace & Tiernan Products, Inc.

93 **Clarifying and Softening Water**—Eight-page catalog "Reactivator for Clarifying and Softening Water by Upward Sludge Filtration." First part of the booklet tells how the reactivator works and how the sludge blanket is kept in control so as not to flow out with the clarified water. Line diagrams illustrate the principle of operation. Graver Tank & Mfg. Co., Inc.

94 **Feed Water Treatment**—This four-page folder tells how the company's engineering applied to boiler feed water problems can result in savings. It tells of the different procedures and presents diagrams of equipment arrangement. Typical installations in dairy, cosmetic, aircraft, laundry, and other plants are pictured. Illinois Water Treatment Co.

95 **Chemical Feeding and Proportioning**—Bulletins 1100 and 1713A; use of adjustable chemical feeder for water treating, sewage, chemical processes, petroleum; plan and sectional diagrams; descriptions; photos; general specifications; 2-page table of capacity schedules; list of chemicals handled; accessories; drawings of boiler water conditioning systems; 5-page description of method of automatic intermittent feed of conditioning chemicals direct to the boilers; 20 pages. Proportioneers, Inc.

96 **Automatic Proportioning**—Bulletin 1200, 28 pages. Handy reference book containing wealth of information on automatic flow responsive equipment and methods in continuous process operation. Photos of equipment and installation are supplemented by many flow diagrams and detail drawings. Complicated subject made exceptionally clear and understandable by careful arrangement and two-color diagrams. Proportioneers, Inc.

Here's How

ADVERTISING

by selling more goods to more people

MAKES YOUR JOB MORE SECURE

NO matter what your job today, it depends on "good business." And someone has said that in the American business system, nothing can be accomplished until "something is sold."

You know the truth of this. Falling sales mean pay cuts, layoffs, fear. Increased sales mean better pay, promotions, more security in every job for every man.

Advertising is the low-cost, efficient way to sell goods. Advertising is the spark plug of business. So advertising, by selling goods, makes your job, your home, your income *more secure!*

Other Ways Advertising Helps You

1. Brings you better goods for less money.
2. Makes shopping more pleasant and easier.
3. Has given us the world's highest standard of living.

Power Plant Engineering

97 **Chemical Proportioning Equipment**—Bulletin 1714 covers chemical proportioning equipment for sea-going service. Two units—for high or low pressure—are described fully. Tabular material assists in the description. Proportioneers, Inc.

98 **Water Conditioning Instruction Booklet**—Bulletin 28X6385 was written especially for guidance of power plant operators. It touches upon importance of feedwater control, care of testing equipment, obtaining samples, test procedures. Handy reference tables given as aid to reporting results. Allis-Chalmers Mfg. Co.

99 **Complete Water Conditioning Service**—This four-page bulletin describes this company's complete water conditioning service—analysis, design fabrication, installation and maintenance of water treating equipment. Typical installations are pictured and brief sketches of the men behind the service are given. Graver Tank & Mfg. Co., Inc.

COATINGS, TREATMENT

100 **Protective Coatings**—4 page folder 844-246 describes Bitumastic Hi-Heat Gray, a specialized industrial protective coating which is said to resist corrosion and temperature up to 1200 F. The folder is in 2 colors and contains several photographs of equipment on which Bitumastic has been applied. It also gives a list of uses for the material and a chart giving its characteristics. Wailes Dove-Hermiston Corp.

101 **Fuel Oil Traatment**—A 4-page bulletin, telling about the company's treatment for fuel oil called "No Sludge." Advantages of using the treatment such as stepping up efficiency and reducing operating costs are explained. A list of dosages and applications is also given. A free test offer of the treatment is explained on the first page of the bulletin. Dominion Chemical Co., Inc.

102 **Flue Cleaner**—The company's soot and fire scale removing compound is described in this six-page folder. Results obtained from the use of this compound are described in the first part of the folder and then a list of the things which the company guarantees the material will accomplish are listed. Tables of dosage are presented and another table shows losses due to soot and fire scale. Dominion Chemical Co., Inc.

103 **Boiler Rust Treatment**—This four-page bulletin describes the company's "Rustoff" chemical which is said to "build resistance to rust and scale corroded and congested pipes." The bulletin tells how the treatment works and what results may be expected from its use. A brief description of the company's service department is included. Dominion Chemical Co., Inc.

104 **Fuel Oil Treatment**—Several bulletins have recently been announced by this company describing completely the application and effect of its fuel oil treatment compound and Diesel engine solvents. Wilcolene Mfg. Co.

HEATING, COOLING

105 **Cooling, Heating, Air Conditioning**—Collection of bulletins; installation, design, construction data, capacity ranges, condensed physical data, numerous photos of installations, full page color diagrams of flow of air, compressed air, water, water spray, etc. Niagara Blower Co.

INSULATION

106 **Industrial Insulations**—Block, blanket insulations; pipe covering; new pressure coverings; insulating cement; felt; Koldboard; fill insulation; diatomaceous earth products; uses, specifications, applications, preparation; charts; photos; list prices; 26 pages. Baldwin-Hill Co.

107 **Insulating Cement**—Ease of application, efficiency; ease of maintenance application recommendations; heat loss calculations, 4 pages. Baldwin-Hill Co.

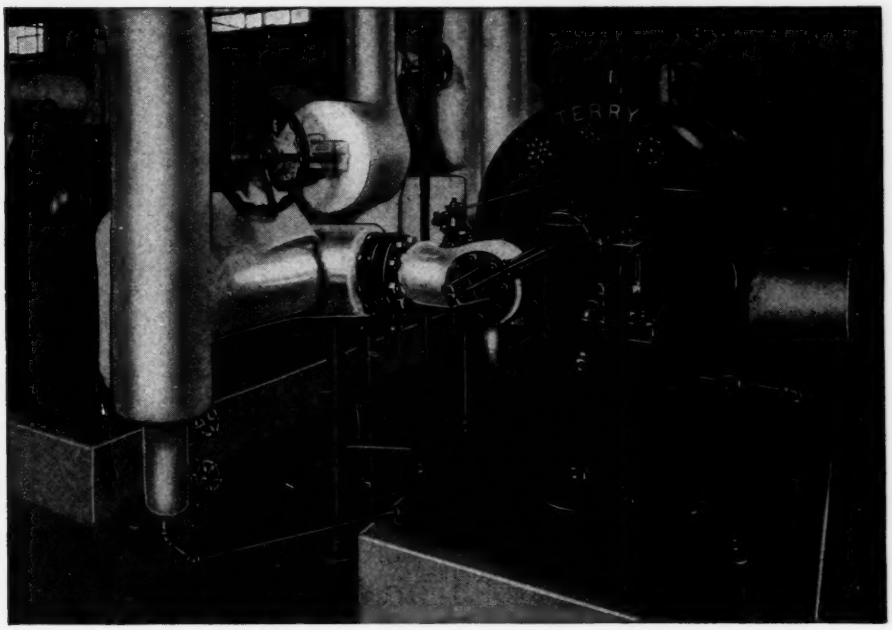
STOKERS

108 **Air-Cooled Stoker**—Catalog R-A; features of construction; how timing device works; installation drawings, ash discharge, air cooling features; features of front end driving mechanism; engineering data tables; 20 tables. American Engineering Co.

109 **Water-Cooled Stoker**—Catalog W; drawings of installations; features; furnace views; 8 pages. American Engineering Co.

110 **Spreader Stoker**—Installation views; features of various parts; cross-sectional view of furnace with installation; listed features; 8 pages. American Engineering Co.

TERRY



GENEROUS BLADE CLEARANCES IN THIS 900° TERRY WHEEL TURBINE INCREASE DEPENDABILITY . . . .

The 290 H. P. Terry Turbine shown above is used for Boiler Feed Pump Drive in a recently completed central station. It operates with steam at 850 lbs.-900° F. and employs a Terry one piece wheel, as illustrated at the left.

The blades of this Turbine have large radial and axial clearances. They are further protected by projecting rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the radial clearance became reduced. It is therefore impossible for the blades to foul.

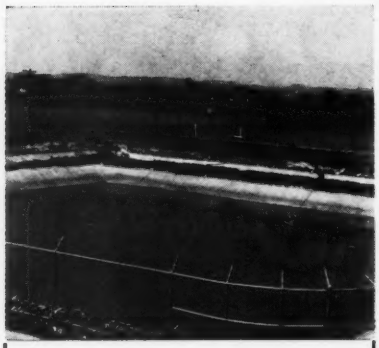
The side clearance is very large - one inch - so that end play can do no damage.

Such construction makes for dependable operation.
- Descriptive bulletins sent on request. Ask for S-116.

T-1167

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

XUM



SATISFACTION or NO CHARGE . . .

That's the basis on which STONHARD STONTITE is used by power plants of leading organizations all over the world. STONTITE is ideal for the repair of dams, tunnels, below grade pits and basements. Try a drum at your plant!

Send for Free 48-Page Booklet

This valuable guide to better building maintenance is packed with facts about the repair of walls, floors and roofs. It's yours for the asking, return the coupon.

STONHARD COMPANY

Building Maintenance Materials

Serving Industry Since 1922

810 Terminal Commerce Bldg.

Philadelphia 8, Pa.

STONHARD COMPANY
810 Terminal Commerce Bldg.
Philadelphia 8, Pa.

At no obligation to us please send STONTITE information and a free copy of "Over the Rough Spots".

Firm .....

Mr..... Title.....

Address .....

City..... Zone.... State.....

111 **Pneumatic Spreader Stoker**—Threefold booklet on the inner pages of which there are 30 spirally-bound vertical pages which fold back to tell the story of the stoker, installation, features, construction, principles, engineering, types and models, typical installations; well illustrated; 33 pages. Iron Fireman Mfg. Co.

112 **Poweram Stoker**—Bulletin 7121; essentials of successful stoker; fuel control, fuel conveying, ran capacity, controls, installation; illustrations; 18 pages. Iron Fireman Mfg. Co.

113 **Coal Reference Bulletin**—Bulletin 8, Underfeed Stoker Firing, Bulletin covers factors involved in selection of multiple retort stokers, principles, design data and drawings of typical installations; 6 pages. Fairmont Coal Bureau.

114 **Stoker Firing Operation**—Single Retort Underfeed Stoker Firing is the subject of Bulletin Number 9 issued by this Bureau. It is a complete analysis of the advantages of the single retort stoker in the smaller plants. Types of this stoker are described and principles of operation are outlined. Fairmont Coal Bureau.

OIL, GAS BURNERS

115 **Wide Range Oil Burning System**—Bulletin 109; How the system operates; control, drawings; 4 pages. Peabody Engineering Corp.

116 **Oil Burners**—Bulletin 108; Two types of oil burners, A and H; air registers, oil atomizers, drawings; 4 pages. Peabody Engineering Corp.

117 **Gas Burners**—Bulletin 203; description of A and H gas burners; cross-sectional diagram; photos of atomizers; 4 pages. Peabody Engineering Corp.

OIL, LUBRICATION

118 **Lubrication Recommendations**—Special oils for Diesels and heavy-duty gasoline engines; facts about oil; tables of recommended oils for various models; 18 pages. Standard Oil Company of California.

119 **Cutting Fluids**—Facts about cutting fluids; machine tool operations; fundamentals of cutting; how to apply; metallic cutting tools; tabular material; show practices; 50 pages. Standard Oil Company of California.

120 **Diesel Operation**—Relation of fuels and lubricants in the operating efficiency in the diesel engine; diesel fundamentals; maintenance; lubrication and fuels; supercharging; selection and classification of fuels; fuel injection maintenance; improving cleanliness; tabular material, charts, formulas; 114 pages. The Texas Co.

121 **Engineers Report on Oil**—Engine tests, laboratory tests, effects on engines, bearing corrosion, actual service data, filter clogging, service experience; well illustrated with photos and charts; 42 pages. Standard Oil Company of California.

122 **Lubricants Service Handbook**—28 pages in this booklet on lubricants and their application. The development of the lubricant, its features and advantages and the manner in which it meets various operating conditions take up the fore part of the booklet. "Recommendations" section where the manufacturer tells just what grease or oil should be used according to speeds, temperatures, pressures and general service conditions is given. Fiske Brothers Refining Co.

123 **Oil Products for Industry**—Cutting oil, processing oils, general lubricants, refrigeration oils, Diesel oils, solvents, greases and waxes are among the petroleum products for industry which are described in this four-page folder. The various grades of each oil are analyzed and the reasons why they are fitted to each particular job are given. Sun Oil Co.

124 **Lubricania**—The hundreds of specialized lubricants in use today are identified by certain commonly used tests and terms which describe their physical characteristics. In this dictionary of terms, tests and values, the company has highlighted the most important of these. Tide Water Associated Oil Co.

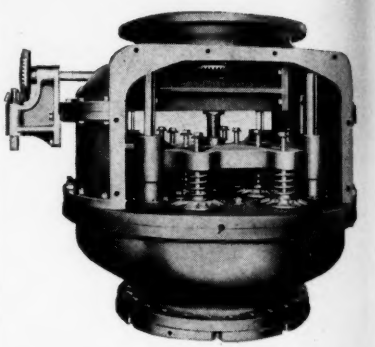
POWER TRANSMISSION

125 **Speed Reduction, Increase Gear**—Bulletin S-130; description; gear cases; gear and pinion; bearings; lubrication; drawings and photos; 8 pages. The Terry Steam Turbine Co.

126 **V-Belt Drive Guide**—Bulletin B6051F; guide to company's complete line of V-belt drives. Contents include types and sizes. V-belt prices, how to figure drives, belt selector charts and tables and similar engineering information. Well illustrated; 12 pages. Allis-Chalmers Mfg. Co.

127 **Flexible Couplings**—Bulletin 57; 2 pages of drawings and tables of rat-

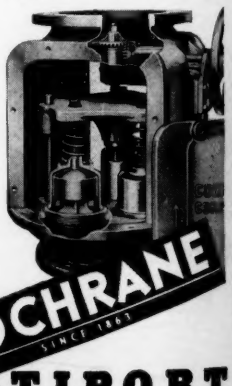
When Teddy ran on the Bull Moose ticket in 1912



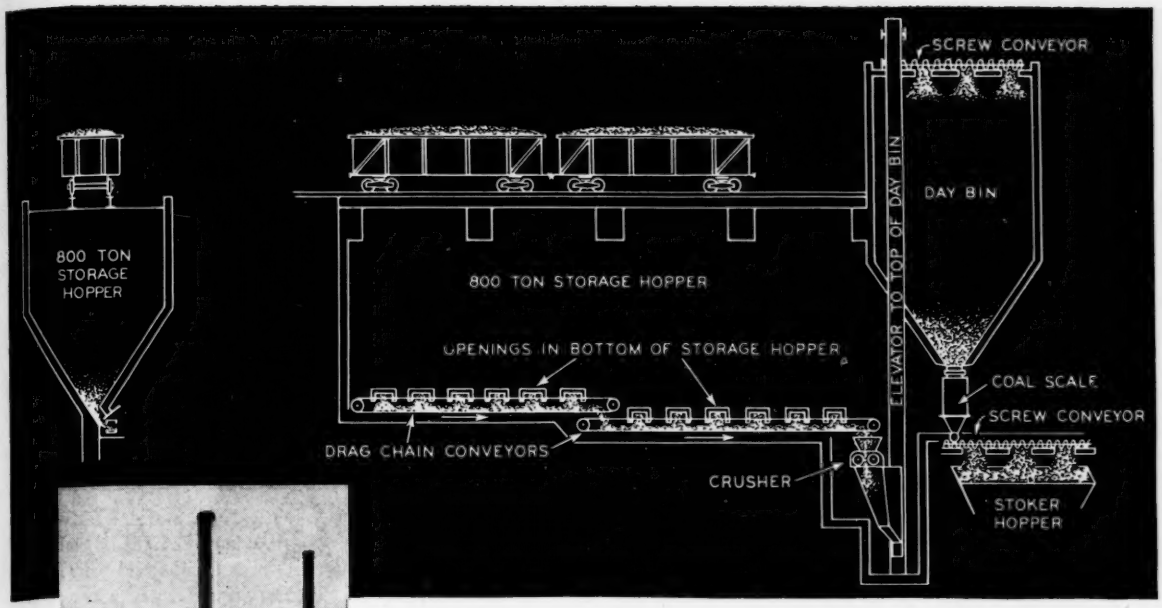
a manufacturer purchased this 30" Cochrane Multiport Valve for 6 lbs. back pressure relief service. For 32 years, this valve was in practically continuous service. Not a single replacement part was furnished nor a single repair made, but in 1944 the customer decided to return it for general overhaul. Very little reconditioning was necessary and the valve was put back in service.

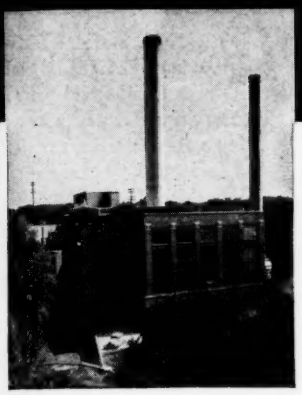
COCHRANE CORPORATION
3123 N. 17th Street, Philadelphia 32, Pa.
Write for a copy of Publication 4150.

Safety, silence and tightness are the outstanding characteristics of the Cochrane Multiport Relief Valve in addition to its long-lasting qualities.

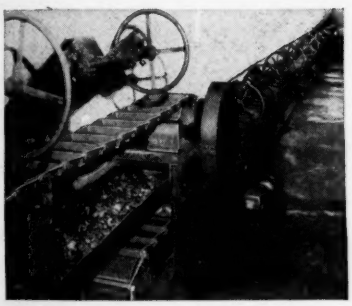


MULTIPORT RELIEF VALVE

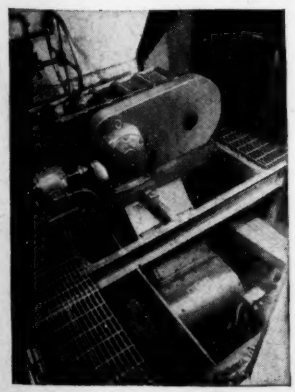




Central States Electric utilizes topography in Coal Handling



Showing Link-Belt "H" Class drag chain conveyors which take coal from bottom of track storage hopper to crusher.



Showing drive arrangement of drag chain conveyor and crusher.

This unusual layout again demonstrates the ability of Link-Belt to engineer and apply equipment to specific conditions for high efficiency and low handling cost.

The hilly nature of the topography was utilized in laying out the coal handling system for Central States Electric Company, Iowa Falls, Iowa. Coal is received at a higher level than the boilers, and goes into a storage hopper holding 800 tons.

A Link-Belt drag chain conveyor takes the coal from the hopper bottom to a crusher, then to a day bin holding 80 tons. From this bin the coal is delivered by screw conveyor through automatic weighing devices to the stoker-spreader conveyor. The stoker has speed regulation in response to load variation, operating through Link-Belt P.I.V. Gear.

The engineering department of Central States Electric Company cooperated with Link-Belt engineers in the development of this layout.

Let us consult with you on your coal and ashes handling layout and equipment problems.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities. 10,791

LINK-BELT

THE SYMBOL OF QUALITY — LB — LINK-BELT

COAL AND ASHES HANDLING EQUIPMENT

Diesels Running Hot?

WHEN insulating deposits of lime scale prevent proper heat transfer, over-heating of your Diesels is inevitable. But that is only the beginning of your trouble, because over-heating is an invitation to power loss and fuel waste.

That's when it's time for effective Oakite descaling to help restore normal cooling efficiency. All you do is circulate a recommended solution of Oakite Compound No. 32 through tubes; allow time for soak; then drain and neutralize. Used as directed, this inhibited acidic Oakite material does a thorough descaling job without damage to surfaces.

Free Help for You

Your nearby Oakite Technical Service Representative will gladly help you get started with the Oakite descaling method. His help on scale removal and related cleaning problems is yours for the asking. Consult him today.

OAKITE PRODUCTS, INC., 18C Thames St., NEW YORK 6, N. Y.
Technical Representatives in Principal Cities of U. S. & Canada

OAKITE

Specialized Industrial Cleaning
MATERIALS • METHODS • SERVICE

ings for company's flexible couplings. Installations are shown and features of the various types are discussed; 20 pages. John Waldron Corp.

VALVES

128 **Regulating Valve**—Bulletin 1-A; valve data book, description, dimensions and lists of parts; typical installations, rated capacities; prices; 52 pages. Atlas Valve Co.

129 **Pressure Regulator**—Bulletin 1-B; description, installation, operation; list prices; sectional and installation views; parts lists; 8 pages. Atlas Valve Co.

130 **Pressure Reducing Valve**—Bulletin 1-C; sectional drawings, list prices, dimensions and weights; operation and adjustment; capacities for steam and air; 12 pages. Atlas Valve Co.

131 **General Service Valve**—Bulletin E-150; valves for blow-off; fire protection, soot blower lines, acids, process etc.; description; exploded views; features; dimensions, weights and list price tables; parts and parts lists; 14 pages. Everlasting Valve Co.

132 **Valve**—Bulletin E-100; for boiler room service; photos, descriptions, parts; features; pressure rating indexes; size, shipping weight and price tables; ordering information; 30 pages. Everlasting Valve Co.

133 **Multiport Relief Valve**—Bulletin 4150; complete description of valves and operating characteristics, photographs of typical installations. Engineering data includes sizing information tables, nomenclature, installation and operation, list of prices of accessories, dimensioned drawings and tables of dimensions; 28 pages. Cochrane Corp.

134 **Diaphragm Motor Valves**—24 pages. Covers Why and How of unit's design. Materials specifications given as are two pages of engineering information and charts. Kieley & Mueller Inc.

MAINTENANCE

135 **71 Maintenance Jobs**—This guide tells how better to perform commonly occuring power plant maintenance and cleaning operations. Illustrated manual gives specific material and method recommendations for handling cleaning, degreasing, descaling, derusting, paint stripping, etc. Booklet is completely indexed and reference is made by colored type strips on edge of the pages; 22 pages. Oakite Products, Inc.

136 **Protecting Metal**—High heat resistant coatings for protecting metal surfaces in power and processing equipment are covered in 4 page bulletin. Brief description of properties of coatings are given. The Dampney Co. of America.

137 **Condenser Tube Inserts**—Description of Flowrites; illustrated, accompanied by report of tests on Flowrites made by M.I.T. Tables and charts of test results are presented; description of how to install inserts given; 8 pages. Condenser Service & Engineering Co., Inc.

CONTROLS, METERS

138 **Damper Regulators**—Bulletin 4-A; for low pressure heating, medium pressure power and high pressure power boilers; what they do; how to specify; typical installations (drawings); adustments; list prices; technical descriptions and parts lists; 20 pages. Atlas Valve Co.

139 **Thermostats and Relays**—Bulletin T, a 12 page catalog presents significant information on this company's mercurial thermostats and adustable thermoregulators. Also included is complete data on relays, designed as companion instruments to the above mentioned. Complete descriptions of the instruments are included and the bulletin is well illustrated. Precision Thermometer & Instrument Co.

140 **Recording Flow Meter**—Bulletin 349; what it does, features, chart of rated capacity; construction and operation; installation drawings, tables of capacity; photos; 8 pages. Builders-Providence, Inc.

141 **Propeller-Type Meter**—Bulletin 350A; for main-line metering; applications, description, installation, materials of construction; features; table of capacity, shipping weights; specifications, drawings; 4 pages. Builders-Providence, Inc.

142 **Centralized Combustion Control**—Bulletin 43-605; application to various types fuels and burning equipment; controller, measuring elements, pilot device, power unit, etc.; 24 pages. The Hays Corp.

143 **Combustion Meters**—Bulletin 44-550; reasons why it is accurate, dependable, simple, rugged, easy to install, easy to maintain, speedy, easy to understand; well illustrated by explanatory diagrams; 16 pages. The Hays Corp.

144 **Feedwater Textbook**—"Mechanical Feedwater Regulation for Boilers" by

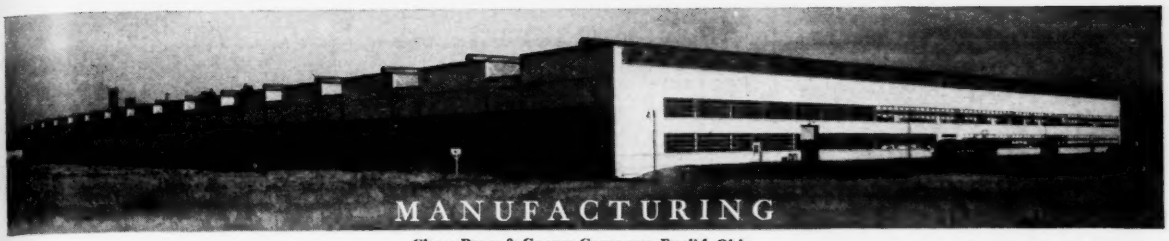
LONGER WEAR
and...
Trouble-free Operation

FRANCE Metal Packing gives maximum sealing efficiency, reduces friction and prevents rod scoring. Records show it lasts longer and lowers maintenance costs. There is a France Metal Packing designed to meet every condition of service on engines and compressors operating at pressures up to 15,000 pounds and more. Consult our engineers on your packing problem.

Write Today for Free Brochure . . . "Industrial Packing"

REPRESENTATIVES IN PRINCIPAL CITIES

FRANCE PACKING COMPANY
PHILADELPHIA 35, PA.

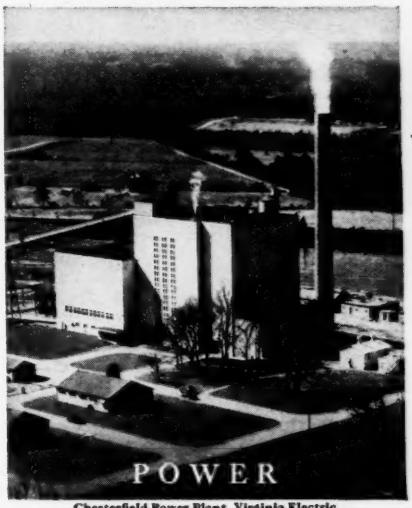


Chase Brass & Copper Company, Euclid, Ohio

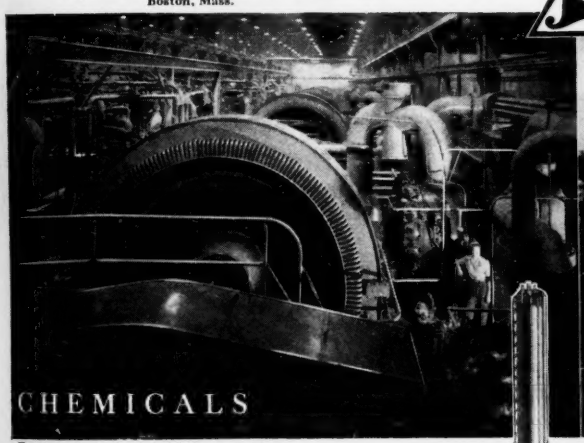
SPECIALIZED KNOWLEDGE IN DIVERSIFIED FIELDS

Proposed Children's Medical Center, Boston, Mass.

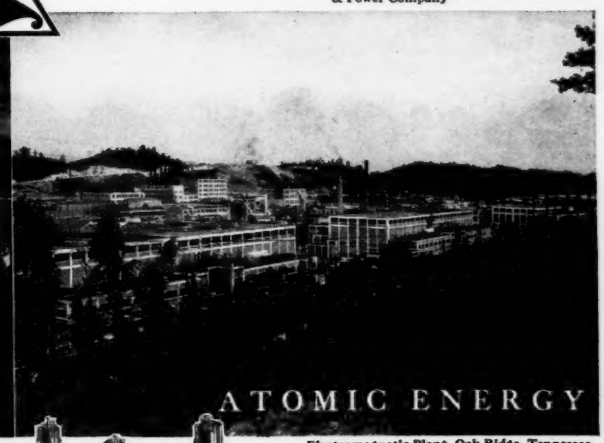
Since 1889, Stone & Webster Engineering Corporation has been engaged in the solution of design, engineering and construction problems. This experience is available to companies looking toward the future.



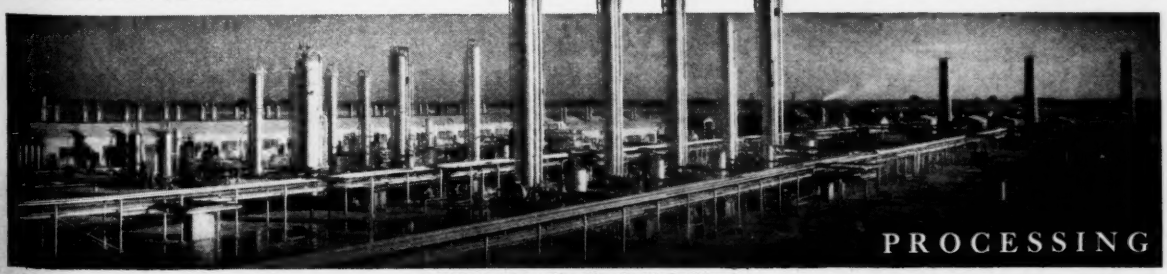
Chesterfield Power Plant, Virginia Electric & Power Company



Tennessee Valley Authority Ammonia Plant



Electromagnetic Plant, Oak Ridge, Tennessee



Erath Cycling Plant, Vermilion Parish, Louisiana

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER INC.

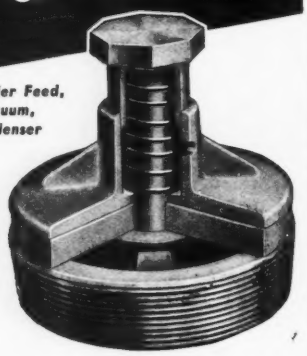
How COMBINATION set the Pace in

Maintaining

PUMP

CA-PAC-I-TY

For Boiler Feed, Vacuum, Condenser



1

Back in 1915 we secured a patent based on the idea that a spring-loaded telescope permitted a minimum of opening for a maximum of flow, and a quick closing which eliminated slippage.

2

Today, *maximum* capacity through the water end of thousands of reciprocating pumps is being assured by COMBINATION Pump Valve Type B Assemblies. It will pay you to write for folder describing operating features, dimensions, prices.

Combination Non-Slip Pump Valves Match the Fine Performance of COMBINATION Silent Check Valves.

COMBINATION PUMP VALVE CO.

846 Wiota St. Philadelphia 4, Pa.

Prof. E. P. Culver; principles of feedwater regulation; mechanical equipment available; differential pressure control; feed pump control; illustrations, diagrams, charts; 36 pages. Northern Equipment Co.

145 **Engineering Monographs** — Series of eight on automatic combustion control: 1. How Close Can Steam Pressure Be Controlled? 2. Why Operate Automatic Combustion Control from Changes in Steam Pressure? 3. Adapting to the Characteristics of Underfed Stokers. 4. Adapting to Spreader Type Stokers. 5. Adapting to Chain or Traveling Grate Stokers. 6. Adapting to the Characteristics of Pulverizers. 7. Adapting to the Characteristics of Oil Burners. 8. Adapting to the Characteristics of Gas Burners; total 37 pages. The Hays Corp.

146 **Draft Gages**—Bulletin 46-667; gages for indicating, recording of drafts, pressures, differentials, temperatures; pressure-draft tables; description of equipment; differential units, Bourdone tube units, pointer gages, etc.; 20 pages. The Hays Corp.

147 **Draft**—Bulletin 46-472; what draft is; where it is found; how it is measured; what the draft gage tells, where to measure draft and pressure in steam plant; where to connect draft gages; how to install; drawings; 20 pages. The Hays Corp.

148 **Flue Gas Analyzer**—Bulletin 45-668; principle of operation; construction features; technique; models and prices; Burrettes—classifications and uses (table); what flue gas analysis tells us; 16 pages. The Hays Corp.

149 **Indicating, Control Systems** — What they are, what they can do; Bulletin 14B6641. Description of how transmitter, receiver and indicator of systems are constructed, how they work, their advantages and specifications. Illustrated with photographs, diagrams, charts; 12 pages. Allis-Chalmers Mfg. Co.

150 **Water Gages** — Condensed catalog, Bulletin E, of company's complete line of water gages. Each model illustrated and accompanying table gives sizing information; 8 pages. Ernst Water Column & Gage Co.

151 **Stainless Steel Bellows** — Bulletin SSB-46; contains diagrammatic cross-section views and up-to-date information concerning the use of these bellows as equalizers, compensators, expansion joints, flexible connectors for flow control, vapor and steam traps, thermostatic instruments, etc. Completely illustrated; 12 pages. Chicago Metal Hose Corp.

152 **Pitot Equipment**—Three section Bulletin 50; gives complete details of the use of Pitot tubes and rods, instructions in the use of the company's portable Pitot recorder, together with theory, formulae, notations and curves. Completely indexed; 20 pages. Simplex Valve & Meter Co.

153 **Manometers**—Bulletin 200; describes completely this line of fixed and portable manometers for use in water surveys and similar flow rate measurement, valuable engineering data also included. Illustrations include line drawings and photographs; 8 pages. Simplex Valve & Meter Co.

154 **Instruments, Controls for Process**—Bulletin 17; process controllers, control components, measuring components and instrument combinations briefly described and illustrated. Application data such as sizes, pressure standards and ranges are listed; 8 pages. Bailey Meter Co.

155 **Temperature Regulators** — Bulletin 7-A; six types; descriptions; list prices, tabular material, photos; list of parts; typical installation drawings; tables for finding sizes of control valves required to heat given quantity of water; 16 pages. Atlas Valve Co.

156 **Draft, Excess Air and CO_2**—Bulletin 39-341; discussion of the relation of these elements to the installation and servicing of bituminous and anthracite stokers by Arnold Soller; 12 pages. The Hays Corp.

157 **Liquid Level Controllers** — Bulletin A-100 is a four-page catalog describing this company's Types G and D liquid level regulators. Excellent cross-sectional views of the units are presented and their operational and constructional features are described. Dimensions, capacities and shipping weights are presented. Stets Company.

158 **Boiler Feed Control**—Bulletin 463, 16 pages, describes boiler feed control systems at Westover, Greenidge and Jennison Stations of N. Y. State Electric and Gas Corp. Completely illustrated with photos and line drawings. Tables of significant data included. Northern Equipment Co.

159 **Water Level Control** — "Controlling Water Level on Combustion Engineering Type VU Boiler," is title of Bul-

MORE Horsepower Per Boiler Where

SAND-BANUM

Is Used for the

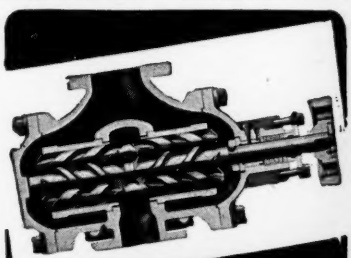
automatic removal and prevention of scale and corrosion while your equipment operates. Requires no expert handling—comes ready to use as is — all active ingredients.

For More Power With Less Fuel WRITE TODAY for the Facts

"The Entirely Different Boiler and Engine Treatment"

AMERICAN SAND-BANUM COMPANY, Inc.

9 ROCKEFELLER PLAZA, NEW YORK CITY 20



THE IMO PUMP IS RELIABLE BECAUSE IT IS SIMPLE....

The IMO pump has only three moving parts and no valves, timing gears, pistons, cams, vanes or delicate adjustments to get out of order or require maintenance.

IMO pumps have an outstanding record of trouble-free performance in lubrication, hydraulic, governor and fuel oil services.

For further information send for catalog 1-135-K.

IMO PUMP DIVISION of the DE LAVAL STEAM TURBINE CO. TRENTON 2, NEW JERSEY

"For commercial or industrial installation, I recommend Todd Burners"

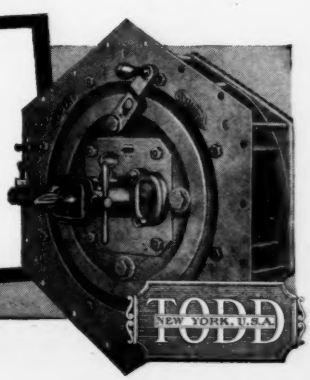
...for minimum fuel consumption, TODD BURNERS

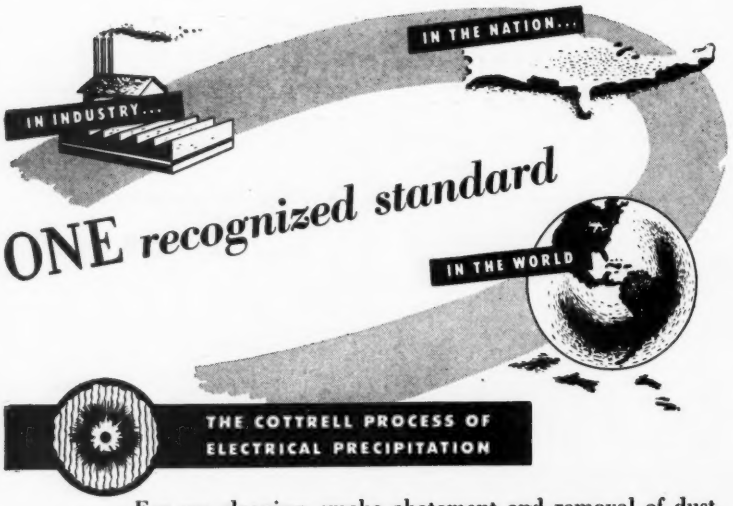
THE costs of operating mechanical equipment are being examined today with the strictest possible scrutiny, for they offer the most fruitful opportunity for *reducing* overall operating expense in both commercial buildings and factories. In the field of heat and power, Todd Oil Burners provide real possibilities of pulling down both day by day charges, and long range maintenance expense, wherever obsolete oil burning equipment is used. In many such cases fuel consumption, for instance, has been cut as much, or more, than 10%. *While for a new building,* Todd Burners offer the opportunity to start operations with top efficiency.

Consult Todd engineers on your heat and power requirements!

COMBUSTION EQUIPMENT DIVISION
TODD SHIPYARDS CORPORATION
81-16 45th Avenue, Elmhurst, Queens, N. Y.

NEW YORK, BROOKLYN, ROCHESTER, HOBOKEN, NEWARK, PHILADELPHIA, CHICAGO, CHARLESTON, S. C., BOSTON, SPRINGFIELD, MASS., BALTIMORE, WASHINGTON, DETROIT, GRAND RAPIDS, TAMPA, GALVESTON, MOBILE, NEW ORLEANS, LOS ANGELES, SAN FRANCISCO, SEATTLE, MONTREAL, TORONTO, BARRANQUILLA, BUENOS AIRES, LONDON





ONE *recognized standard*

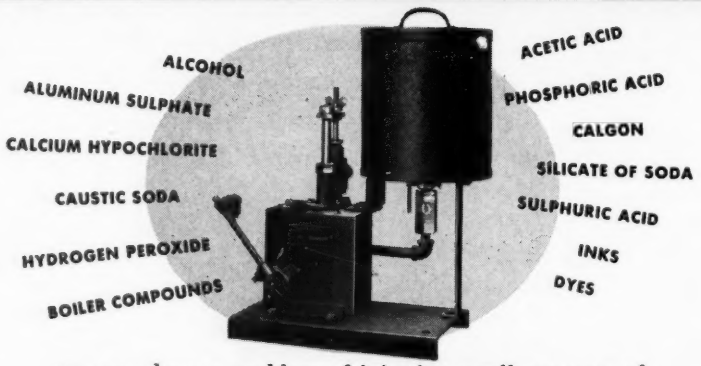
THE COTTRELL PROCESS OF ELECTRICAL PRECIPITATION

For gas cleaning, smoke abatement and removal of dust, fume, tar and other suspended matter from gas, there has been one universally accepted process for more than thirty years. In answer to your special problem, a Cottrell installation incorporating this rich experience in research, development and worldwide operation means the complete fulfillment of your requirements.

RESEARCH CORPORATION

NEW YORK 17: 405 LEXINGTON AVENUE
CHICAGO 3: 122 SO. MICHIGAN AVENUE

Always the *EXACT* Proportion with MANZEL Chemical Feeders



Do you have a problem of injecting small amounts of one liquid into another... in unvarying, accurate proportions? If so, consider Manzel Chemical Feeders. In boiler water and oil line treatment their record of dependable, trouble-free operation is unsurpassed. Let us show you how Manzel Feeders can serve your needs as well.

Manzel Inc. now supplies repair parts for all models of Bowser and Torrington Lubricators.

Builders of HIGH PRESSURE METERING PUMPS Since 1898

Manzel INC.

A Subsidiary of Frontier Industries, Inc.
327 Babcock Street Buffalo 10, N. Y.

letin 455. These four pages present photos and chart reproductions and tell the details of the company's control equipment on this particular type of boiler. Northern Equipment Co.

160 **Water Level Control**—Bulletin 459, 8 pages, description of water level control installation at Wyman-Gordon Co. Good illustrations show details of installation. Table of significant data given. Northern Equipment Co.

161 **Boiler Water Level Control**—Bulletin 467 and 465, 8 pages each, describe respectively, control installations at Buzzard Point Plant and West Reading Station. Both give exceptionally detailed reports of the installation complete with tables, photos and drawings. Northern Equipment Co.

PACKING GASKETS

162 **Packing** — Bulletin 237; photos and descriptions of use; installation drawings; standard size table; 4 pages. Warren Steam Pump Co., Inc.

FITTINGS

163 **Standards for Flanged Fittings, Valves, Flanges**—Pressure temperature ratings, tables and charts, rating procedure, flange materials, safety factors, loading, stress formulas; 20 pages. Tube Turns, Inc.

164 **Welding Fittings**—Allowable working pressures; power, oil, district heating, refrigeration, gas and air piping; 14 tables and directions for use; 18 pages. Tube Turns, Inc.

165 **Welding Fittings**—Volumetric capacities, 2 pages of formulas for computation of capacities; 6 pages of tables; 12 pages in book. Tube Turns, Inc.

166 **Unions**—Complete line of malleable iron unions and convenience unions; illustrations, descriptions, size and list prices; descriptions of materials and workmanship; 24 pages. Jefferson Union Co.

PUMPS

167 **Horizontal Duplex Piston Pumps**—Bulletin 230-1; specifications, steam end, liquid end; capacity tables for pressure service, light pressure service; dimensions, drawings, tables; 4 pages. Warren Steam Pump Co., Inc.

168 **Steam Heat Vacuum Pumps**—Bulletin 226-1; specifications, drawings, general information, tables of sizes and capacities; 4 pages. Warren Steam Pump Co., Inc.

169 **Centrifugal Pumps**—Bulletin 302-30, Revised; instructions for installation and operation; drawings, tabular material; 12 pages. Warren Steam Pump Co., Inc.

170 **Hydraulic Pressure Pumps**—Bulletin 238; specifications, sectional photos, important features; full page table of capacity, sizes, pipe sizes, pressure; 4 pages. Warren Steam Pump Co., Inc.

171 **Screw Pumps** — Recommended uses; advantages; tables of capacities and sizes; charts of test results; dimensioned drawings; suctions and discharge, packing box sizes, shipping weights tables; specifications; installation and maintenance; theoretical horsepowers; viscosity classifications; 18 pages. Sier-Bath Gear & Pump Co., Inc.

172 **Centrifugal Pumps**—Booklet describes basic action of centrifugal pumps, tells of the science of centrifugal action and the physics of pumping. Performance curves are presented. Descriptions of the company's self-priming centrifugal pumps are given and how they operate is explained. Typical use of the units are pointed out and installation and operation explained; 20 pages. Marlow Pumps.

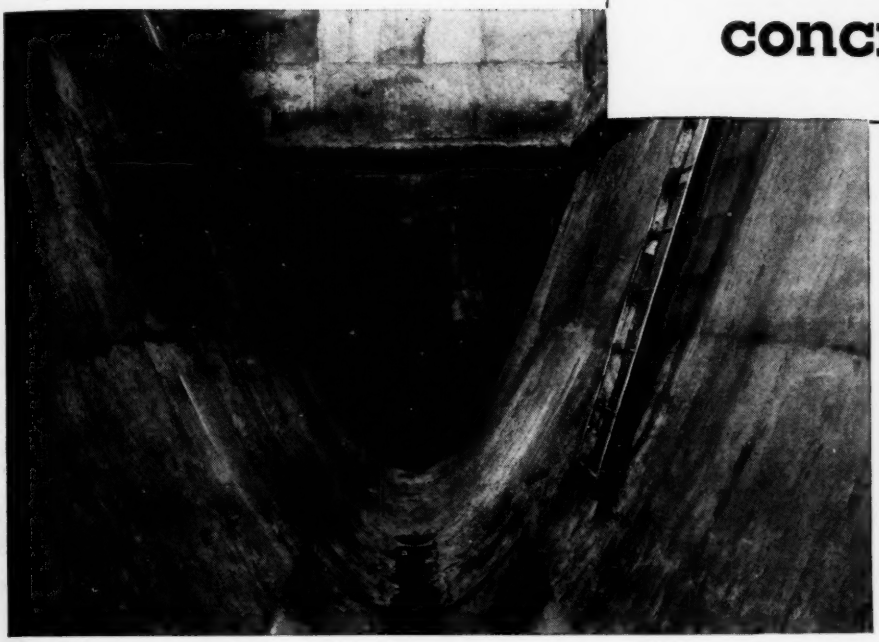
173 **Centrifugal Pumps**—Bulletin 240, 6-page folder describing single stage, double suction, Type DBL centrifugal pump. Features of the pump resulting from its construction and engineering: a sectional view which is used to point out other advantages of the unit. Tables of metal specifications and capacity ratings in gallons are also given. Warren Steam Pump Co., Inc.

174 **Multi-Stage Pumps**—Bulletin 241 describes 4 and 6 stage Type TM pumps. Cross-sectional illustrations and tables of specifications are given. Dimensioned drawings and tables of dimensions accompany copy describing unit's construction and advantages. Warren Steam Pump Co., Inc.

175 **Close-Coupled Pumps**—Close-coupled pumps, called Compac-units, are described in Bulletin 242. This eight-page bulletin presents clear and understandable cross-sectional photos of the units and uses these to point out construction and operation features. A full-page "Composite Rating Table" presents rating information at various heads for 9 different models of pumps. Warren Steam Pump Co., Inc.

176 **Compressors, Vacuum Pumps**—Bulletin C-5; 16 pages. Describes complete

Coal bunkers give longer service when armored with LUMNITE concrete



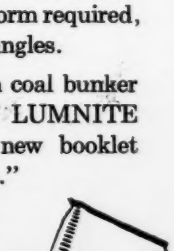
CORROSIVE action of sulphur compounds leached from coal is easily checked with rugged bunker linings of LUMNITE concrete. In close contact with the steel, the dense concrete prevents corrosive water from working in behind the lining and attacking the steel.

LUMNITE is a special hydraulic cement of the calcium-aluminate type and is not a portland cement. A structural cement for rapid construction, it is used with selected aggregates to make corrosion-resistant concrete.

Tough, dense LUMNITE concrete resists abrasive wear. Monolithic, one-piece construction does away with joints which may roughen up, tear out, cause leakage and expose the steel to corrosion.

Installation is easy. The LUMNITE lining can be shot on with a cement gun, plastered by hand or cast in place to exact form required, regardless of curves, corners and angles.

Write for further information on coal bunker linings as well as other uses of LUMNITE in power plants. Also, ask for new booklet "Concrete Linings in Steel Stacks."



Lumnite Division

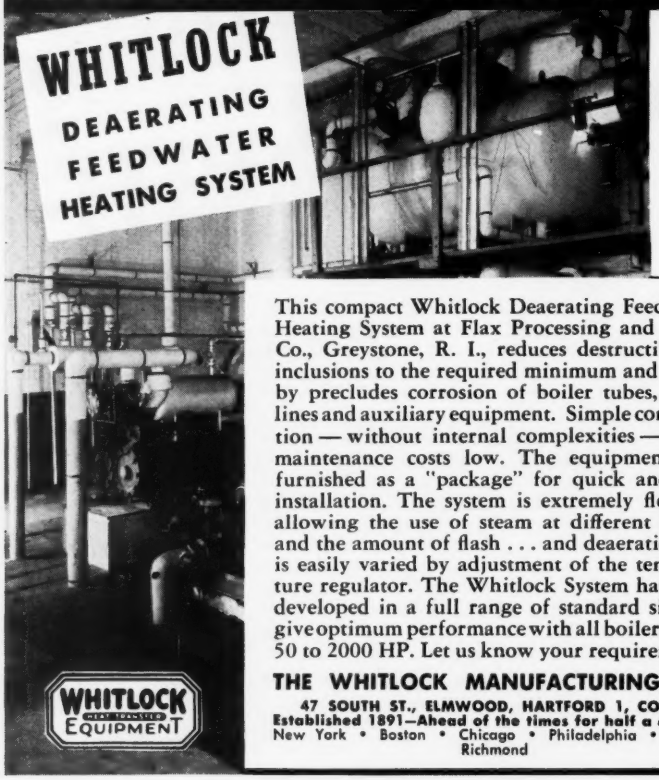
UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL CORPORATION SUBSIDIARY

135 EAST 42nd STREET • NEW YORK 17, N. Y.

REDUCE CORROSION . . INCREASE BOILER LIFE

WHITLOCK
DEAERATING
FEEDWATER
HEATING SYSTEM



This compact Whitlock Deaerating Feedwater Heating System at Flax Processing and Linen Co., Greystone, R. I., reduces destructive gas inclusions to the required minimum and thereby precludes corrosion of boiler tubes, steam lines and auxiliary equipment. Simple construction — without internal complexities — keeps maintenance costs low. The equipment was furnished as a "package" for quick and easy installation. The system is extremely flexible, allowing the use of steam at different levels, and the amount of flash . . . and deaeration . . . is easily varied by adjustment of the temperature regulator. The Whitlock System has been developed in a full range of standard sizes to give optimum performance with all boilers from 50 to 2000 HP. Let us know your requirements.

THE WHITLOCK MANUFACTURING CO.

47 SOUTH ST., ELMWOOD, HARTFORD 1, CONN.
Established 1891—Ahead of the times for half a century
New York • Boston • Chicago • Philadelphia • Detroit
Richmond

WHITLOCK
DEA-RATOR
EQUIPMENT

details of construction including illustrative material such as photographs of parts of the units and drawings of detailed structural parts. Tables present size and capacity information. Chart of typical characteristics is given. Fuller Co.

MISCELLANEOUS

177 Floor Resurfacing — This recently-published folder describes the methods of use of the company's heavy-duty resurfacer for use on floors, traffic aisles and loading platforms. It contains a concise, clear description of the properties, methods of application and advantages of the resurfacer and is of interest to everyone who has problems in the maintenance and repair of concrete floors. Stonhard Company.

178 Electric Tools—Bulletin 464; covers complete line of portable electric tools for construction and briefly describes such tools as electric hammers, drills, chisels, vibrating tools, accessories, screw drivers, etc. Prices are given. Syntron Co.

179 Refractory Concrete—"Lumnite for Refractory Concrete"; basic information on materials and methods used in making refractory concrete. Illustrations show application of concrete in construction of furnaces, coke ovens, etc. Lumnite Division, Universal Atlas Cement Co.

180 Gas Purger for Refrigeration System —Bulletin 160; tells how to cut power costs and raise condenser capacity by proper purging of non-condensible gases. Tables of ammonia properties, advantages and complete illustrated material. 8 pages. Armstrong Machine Works.

181 Grinding Wheels — Grinding wheels of various abrasives are illustrated and list prices presented; tables of sizes in inches are accompanied by photographs and line drawings of these various wheels. Grinding wheel dressers with list prices are shown; 32 pages. Norton Co.

182 Weldments—Bulletin SP106 tells about the services of this company's weldry and the weldments turned out therein. The products of this weldry are shown and the text points out how flexible the method is. Graver Tank & Mfg. Co., Inc.

183 Drop Forged Flanges—Manufacturing processes; physical characteristics; full-page tables of illustrations, dimensions, weights and prices. Space provided for future insertions. Phoenix Mfg. Co.

Consult Us For:
CHIMNEYS . . .
FURNACE WORK . . .
BOILER SETTINGS

AMERICAN CHIMNEY CORP.
141 Fourth Ave., New York 3, N. Y.
BRANCHES:
BOSTON • PHILADELPHIA • CLEVELAND
DETROIT • PITTSBURGH • CHARLOTTE

QUIK-LABELS
CODE CARD SYSTEM

Removable Self-Starter Strip exposes ends of Labels for you to peel!
DON'T PICK. USE SELF-STARTER STRIP TO PEEL LABELS.
FREE SAMPLES
DON'T PICK. USE SELF-STARTER STRIP TO PEEL LABELS.
1 PEEL
2 APPLY
3 IDENTIFY
LIKEWISE ON FLAT SURFACES
*Patents Pending

QUIK-LABELS
Mark Your Wires Faster

QUIK-LABELS code Wires, Leads, Circuits, Relays, Parts, etc., faster and cheaper. • Pre-cut to exact size. QUIK-LABELS come on handy cards. • Ready to use, they stik-quik without moistening, replace slow and costly string tags, roll tapes, decals, stencils, metal tabs, etc. • Silicone plastic coated to resist dirt, grease, abrasion. • *Self Starter Strip automatically exposes ends of Labels for you to grasp instantly—no more finger-picking.

Write for Folder and FREE Sample Cards

W. H. BRADY COMPANY
Established 1914
Manufacturers of Self-Sticking Tape Products
248 W. Wells St., Milwaukee 3, Wis.
Factory—Chippewa Falls, Wisconsin

ASK FOR THE
friction-free
STETS
FEED REGULATOR

In Two Models for
wsp 400-600 lb.
and 600-900 lb.

Operation of Stets High Pressure Feed Regulator is based on change of liquid level only. Absence of a stuffing box avoids any friction effect; assures faster response to minute changes in liquid level. Other important features of this unit are described in Catalog No. 143. It also tells about design and performance of Stets Low Pressure Regulators.

STETS COMPANY
1440 Broadway • New York 18, N. Y.

Why **BROS** uses HYDRAULIC DRIVE in the Travl-Spred Stoker

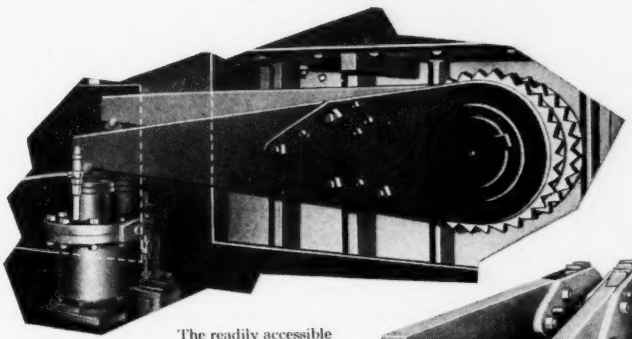
• The revolutionary *Bros* Travl-Spred Stoker combines the traveling grate with spreader feed to bring new economy, new efficiency to installations of unlimited horsepower. To keep the grate traveling for continuous ash discharge, *Bros* utilizes hydraulic drive for minimum power costs, and a saving of valuable boiler room space. It's this up-to-the-minute design—combined with zoned burning areas and exclusive tuyere type grates—that makes the *Bros* Travl-Spred Stoker the pace setter in the stoker field.

Less Space is required by the compact *Bros* hydraulic drive that operates directly on the main drive shaft of the stoker. Cumbersome gear reductions and variable-speed transmissions, inherent in mechanical drives, are eliminated.

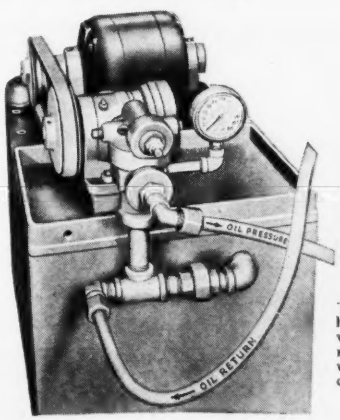
Lower Cost operation is maintained with the streamlined drive that uses only a low horsepower motor for electrical energy.

More Efficiency results from the self-contained oil pumping unit which can be located at any convenient place in the boiler room.

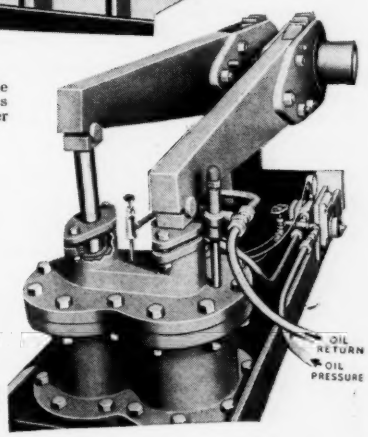
Greater Safety is assured with the relief valve which eliminates safety clutches and shear pins, protects equipment and personnel.



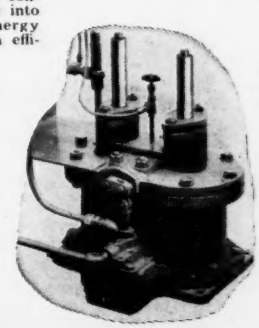
The readily accessible *Bros* power unit is mounted in the stoker housing.



Only electrical unit in entire *Bros* grate mechanism is a low horsepower motor which economically drives pump to energize complete hydraulic drive.



This compact *Bros* hydraulic drive converts hydraulic into mechanical energy with maximum efficiency



The exclusive *Bros* design incorporates duplex cylinders, 4-way valve and pilot valve into one compact unit. Excess piping is eliminated.

BROS

WM. BROS BOILER AND MANUFACTURING COMPANY

MINNEAPOLIS, MINNESOTA

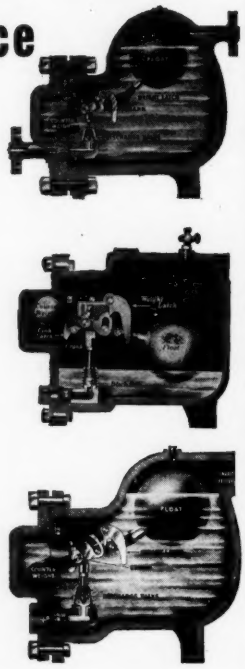
STOP LIVE STEAM LOSS
in Superheat Service

WITH

Nicholson LEAK-PROOFED Weight-Operated Traps

If you are losing live steam in your superheated service, because traps dry up and leak, Nicholson weight-operated traps offer a now widely adopted remedy. Though "cooked" dry, the valve of these traps holds tight due to their weight operation.

SUBSTANTIAL SAVINGS—Steam and fuel savings in substantial quantities are reported from installations of Nicholson weight-operated traps. 4 types; pressures to 1500 lbs. Stainless steel working parts.

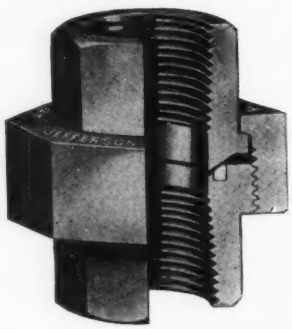


Catalog 444 or See Sweet's

W. H. NICHOLSON & CO.

160 OREGON ST., WILKES-BARRE, PA.

VALVES • TRAPS • STEAM SPECIALTIES



The Feature of the RECESSED BRASS SEAT in the

JEFFERSON UNION

makes it unique

It is cut from seamless drawn tubing—free from all casting defects—sound and uniform always! It cannot be dislodged by a pipe end screwed in too far.

JEFFERSON UNION CO.

601 West 26th St., New York 1, N. Y.

Factories at Lexington 73, Mass., and Lockport, N. Y.

"Boiler Repairs Reduced 75%"

writes user of **NATIONAL GIRTH SEAM PROTECTOR**

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.

Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 928-29 REIBOLD BLDG., DAYTON, OHIO

CONDENSER SERVICE'S METAL SPRAY PLANT

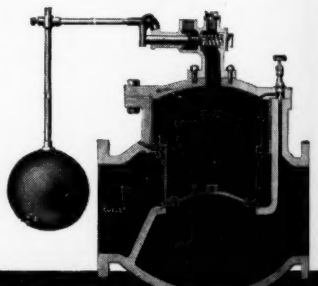
CONDENSER Service & Engineering Co., Inc., announces the opening of a fully equipped plant for development work and metal spray at 601 Newark St., Hoboken, N. J. The company has been engaged in metal spray work for the past 15 years.

The company maintains complete metal spray equipment in its various plants located at Hoboken, N. J., Pottsville, Pa., Edge Moor, Del., and Scranton, Pa. The handling and machining facilities of the various plants enable them to handle any size metal spray job, small or large.

PATENTS AVAILABLE FOR LICENSING

FOLLOWING is a list of patents which have been assigned to the Secretary of the Interior and which are available for licensing. Licenses are customarily issued on a non-exclusive, royalty-free basis.

Application for any of these licenses should be made to the Solicitor, Department of the Interior, Washington 25, D. C. Copies of the patents may be obtained from the Patent Office for 25 cents per copy. Patent No. 2,215,484, Sonic Flocculators and Method of Flocculating Smoke or the Like; Patent No. 2,283,954, Apparatus for Testing the Embrittlement Cracking Characteristics of Solutions; Patent No. 2,283,955, Means for and Methods of Testing Embrittlement Cracking Characteristics of Solutions; Patent No. 2,297,670, Method of Protecting Boilers and the Like from Embrittlement; and Patent No. 2,411,157, Means for Collecting Gas Analysis Samples.

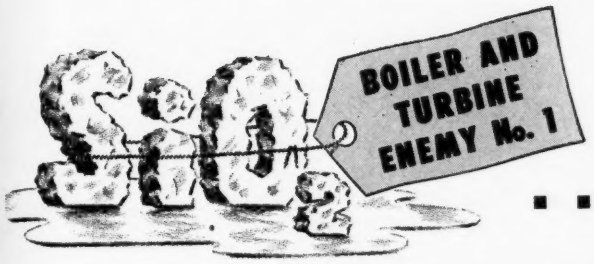


GOLDEN-ANDERSON
HIGH PRESSURE
COLD WATER
Float VALVES

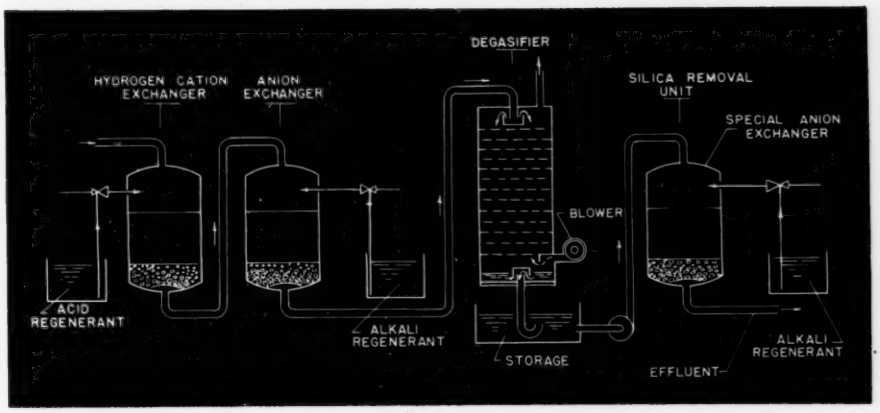
Available in standard sizes from 3 inch to 36 inch, in Angle and Globe Patterns—iron, semi-steel, and cast steel bodies with non-corrosive trim of bronze, Gavalloy or Stainless steel.

100-page descriptive Catalog, free on request.

GA
GOLDEN-ANDERSON
VALVE Specialty Company
PITTSBURGH 22, PA.



. . "liquidated" by LIQUON



To prevent silica deposits in boiler tubes and on turbine blades, the concentration of silica in the steam must be kept below 0.1 ppm, especially in high-pressure plants. This usually means a silica of under 5.0 ppm in the concentrated boiler water.

If you have a silica removal problem, consult the LIQUON engineers. The advice of these recognized authorities in water treatment gives you the benefit of 30 years of specialized experience. From this long experience has been developed not merely one . . . but FOUR . . . proven LIQUON methods of silica removal . . . your assurance of the most effective and economical method for your individual plant conditions. Write for Bulletin 7 for further information.

Remember, too, that whatever your water supply quality difficulties may be — hardness, alkalinity, turbidity, gases, or other impurities — LIQUON can give you exactly the right process, equipment and materials, because LIQUON's services cover the entire field of liquid conditioning.

LIQUID CONDITIONING CORPORATION

114 East Price Street, Linden, New Jersey

Engineering Service Representatives in Principal Cities

Send the Coupon

If you will write us about your water treatment needs, we shall be glad to send you additional bulletins describing suitable LIQUON methods and to offer recommendations without obligating you in any way.

LIQUID CONDITIONING CORPORATION
114 East Price Street, Linden, N. J.

Gentlemen:
Please send me without obligation your bulletin on SILICA REMOVAL.

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....
PPE 9-47

DEPARTMENT OF TECHNOLOGY
BUFFALO PUBLIC LIBRARY

XUM

Are You Equipped to Hold Your Job?—To Get a New One?

The men who are holding good jobs today—who are not worrying about the period ahead—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of a job insurance there is—KNOWLEDGE.

How about you? Do you know how quickly knowledge will pile up—how quickly you will become more valuable—if you spend a few minutes a day, regularly, studying sound books like the McGraw-Hill Library of Power Plant Practice? Do you know how easily it can be managed paying only a few cents a day, while you use the books?

Thousands of men have followed this plan to win advancement or to make their jobs safe. You can too. Read about this Library and our 10 Day Examination Offer. Then send the attached coupon to us today.

POWER PLANT PRACTICE

(6 volumes—2,477 pages, 2,404 illustrations)

The Library of Power Plant Practice is the standard of the power plant field. It is accurate — it is thorough — it is complete. It is the result of years of experience with power plant problems. The man who has it has the best. The Library covers the whole field — nothing is omitted. The solution of every problem is plainly worded or explained with a clear illustration. The little stickers and the big troublesome problems are all worked out in advance for you. There can be only one result from studying these books a few minutes each day—more money in your pocket.

No books dealing with the work of the power plant man were ever so complete — so authoritative — so practical in text and illustrations as these. The man who puts this set of books into his library can do so knowing that he has the utmost in power plant books—a set that will give him, in language he can understand, all the information he needs in order to get ahead in his work.

Easy to Understand

These books are written in everyday easy-to-understand language. They are written to help the man on the job. It is just as if the author were working in the plant by your side and giving you the benefit of his vast knowledge man to man. There's no bunkum in this Library, nor is it cluttered up with impractical theories. It is a **Power Plant Library FOR POWER PLANT MEN.**

Glance at the titles of the books in the photograph. They will give you an idea of how completely this Library covers **Power Plant Practice.** Here you have all the information necessary to make you indispensable on the job.

See it 10 days—Send no money

Fill in and mail the coupon below and we will send you the six volumes of the Power Plant Library for 10 days' Examination. If you decide to keep the books after examining them just send $3.50 and then $3.00 a month until the total low price of $18.50 has been paid. See the coupon below for details. Send it Now and HOLD THAT JOB.

McGRAW-HILL ON-APPROVAL COUPON

McGRAW-HILL BOOK CO., 330 W. 42nd St., New York 18, N. Y.

Ship to me, charges prepaid, the six volumes of the **Library of Power Plant Practice.** If satisfactory, I will send $3.50 in ten days and $3.00 a month until the price of $18.50 has been paid. If not wanted I will return the set to you postpaid. (To insure prompt shipment write plainly and fill in all lines.)

Name .....

Home Address .....

City and State .....

Position .....

Firm or Employer PPE-9-47

(For Canadian price, write McGraw-Hill Co. of Canada, Ltd., 12 Richmond Street E., Toronto, 1.)

DEPARTMENT OF TECHNOLOGY
BUFFALO PUBLIC LIBRARY

POWER PLANT *Construction News*

Ala., Gantt—Alabama Electric Cooperative, Inc., 321 South Cotton St., Andalusia, Ala., has completed arrangements with REA for loan of $3,500,000, majority of fund to be used for construction of new steam-electric power plant in vicinity of Gantt. Proposed to construct transmission and distribution lines, power substations and other operating facilities for service in organization territory.

Calif., Buttonwillow—Pacific Gas & Electric Co., 445 Sutter St., San Francisco, Calif., plans new power substation in vicinity of Midway steam-electric generating station near Buttonwillow, estimated to cost about $3,400,000, with transformers, switchgear and auxiliary equipment. Also will build new switching station at Tesla, near Tracy, Calif., to cost approximately $720,000.

Colo., Sunbeam—Stanolind Pipe Line Co., Stanolind Bldg., Tulsa, Okla., plans new pumping station in vicinity of Sunbeam for booster service for crude oil pipelines in that area. Cost reported about $125,000. Proposed to begin work soon.

Ill., Marshall—Board of Marshall Township Commissioners, Marshall, has plans under way for new electric power plant for service at township buildings, estimated to cost over $250,000, with equipment. Rogers-Schmidt Engineering Co., Railway Exchange Bldg., St. Louis, Mo., is consulting engineer.

Ind., Edwardsport—Public Service Co. of Indiana, Traction Terminal Bldg., Indianapolis, Ind., will begin work soon on superstructure for new power plant at Edwardsport, to be equipped for capacity of about 400,000-kw, divided into several turbine-generator units, with high-pressure boilers and auxiliary equipment. Cost reported over $5,000,000. Completion is scheduled late in 1948. Sargent & Lundy, Inc., 222 South State St., Chicago, Ill., is consulting engineer.

Iowa, Peterson—Northwestern Light & Power Co., Security Bldg., Cedar Rapids, Iowa, has plans for rebuilding oil engine-operated power plant at Peterson, recently damaged by fire with loss reported over $500,000.

Kan., Leavenworth—Cities Service Gas Co., 202-12 North Market St., Wichita, Kan., plans new compressor station for booster service for natural gas pipe line system in vicinity of Leavenworth. It will be equipped for a capacity of about 1600-hp, and is reported to cost approximately $200,000, with compressor units and accessories.

Kan., Wichita—Cudahy Packing Co., Wichita, meat packer, plans installation of electric power equipment in new six-story addition to local plant. Cost over $1,000,000. Work will be carried out at early date. Main offices are at 221 North La Salle St., Chicago, Ill.

La., St. Landry—Central Louisiana Electric Co., 528 Monroe St., Alexandria, La., has approved plans for new steam-electric generating plant in vicinity of St. Landry. Installation will include turbine-generating unit, high-pressure boilers and auxiliary equipment. Cost reported about $2,000,000. Work on superstructure will begin soon.

Mich., Kalamazoo—Sutherland Paper Co., boxboard, chipboard, pulpboard, etc., plans addition to power plant at mill, including installation of new turbine-generator, high-pressure boiler and auxiliary equipment. Project will be carried out in conjunction with new addition to mill for large increased capacity, for which erection will begin soon. Entire program will represent a reported investment of about $2,500,000.

Mo., St. Louis—Anheuser-Busch, Inc., 721 Pestalozzi St., has taken out permit for new boiler house at brewery, multi-story type, about 53 x 74 ft, reported to cost approximately $300,000, with boilers, pumps and auxiliary equipment. Erection will proceed at once.

N. J., Bound Brook—Bakelite Corp., plastic products, plans installation of electric power equipment in new addition to local plant, to be one-story, reported to cost over $200,000. Erection will begin at early date. Main offices are at 30 East 42nd St., New York, N. Y.

N. Y., Utica—Central New York Power Corp., 300 Erie Blvd. West, Syracuse, N. Y., will have plans completed soon for new hydroelectric generating station on Canada

Every

PHOENIX FLANGE

is a precision product

In any drop forging, the product is only as good as the dies. That's why such particular care is taken in their preparation. That's why they're precision made.

A full range of sizes and styles . . . drop forged flanges that stand up under the toughest conditions . . . are available from Phoenix. All are of mild steel readily machined or welded and all meet ASA requirements and ASME and STTM specifications.

Get your copy of the Phoenix Flange Catalog today.

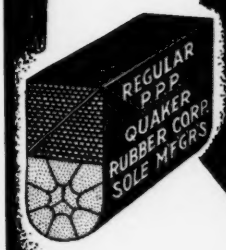
PHOENIX
Drop Forged
FLANGES

PHOENIX MANUFACTURING COMPANY

Joliet, Illinois — Catasauqua, Pa.

LEAKS LOSE MONEY

. . . STOP 'EM QUICK with QUAKER PACKINGS



PISTON ROD PACKING

Daniel's P.P.P. — the unique packing that makes pressure tightly seal itself due to specially-designed sliding wedge action. Seals safely, minimizes friction, assures peak service.

VALVE STEM PACKING

Valvolite Packing provides long leak-proof service for valve stems. Expert construction and lubrication defies drying out . . . stays pliable even under high pressure and temperature. Prevents scoring of stems.

SHEET PACKING

Ebonite Packing stops leaks on high pressure joints and flanges. Won't harden or melt, expands evenly. Ideal for super-heated steam, gas, hot or cold water, oil, acids. Ask your Quaker Distributor for complete data and samples of Quaker Packings.

QUAKER RUBBER CORPORATION

PHILADELPHIA 24, PA.

NEW YORK 7 • CLEVELAND 15 • CHICAGO 16 • HOUSTON 1

Western Territory

QUAKER PACIFIC RUBBER CO. • San Francisco 5 • Los Angeles 21

CRACKS, RUTS, HOLES ask for accidents

STOP THEM THIS WAY

Get rid of danger-inviting cracks in concrete floors with Smooth-On No. 7B Quick Floor Patch Cement. Use it to close up ruts, widened seams, shallow holes and rough spots.

Smooth-On patches harden overnight, ready for traffic. They stay so, for Smooth-On expands a little as it sets, wedging itself firmly in place. Furthermore, Smooth-On No. 7B patches get stronger with age, withstand water, are dust-proof and oil-proof.

Order Smooth-On No. 7B Quick Floor Patch Cement in 5-, 25- or 100-lb. size.

80-218

FREE FLOOR PATCH FOLDER AND METAL REPAIR HANDBOOK

Folder gives full information on patching concrete floors. The 40-page Smooth-On Handbook is full of handy, money-saving repairs on equipment, pipe lines, hardware, tools, utensils, etc. in plant and home. Write for YOUR free copies now.

— — — — — Sign and Send TODAY — — —

Smooth-On Mfg. Co., Dept. 31J
570 Communipaw Ave., Jersey City 4, N. J

Please send me QUICK PATCH FOLDER ☐ HANDBOOK ☐

Name .....

Address .....

9/47 .....

Do it with **SMOOTH-ON**
QUICK FLOOR PATCH CEMENT

Creek, vicinity of Utica, where site has been secured. Project will comprise a power dam, generating station with two 9600-hp hydraulic turbines, electric generating units and auxiliary equipment. No estimate of cost announced. Application for permission has been made to Federal Power Commission, Washington, D. C.

Ore., Roseburg—California-Oregon Power Co., Medford, Ore., will begin work soon on proposed new hydroelectric generating station at Toketee Falls, on Umpqua River, north of Roseburg. Project will include a power dam, power station with hydraulic turbines and electric generators for rating of about 40,000 hp, switching station and other operating facilities. A new transmission line will be constructed from power plant to Dixonville, Ore., about 47 mi. Cost estimated approximately $4,000,000. Public Utility Engineering & Service Corp., 231 South La Salle St., Chicago, Ill, is engineer.

S. D., Vermillion—State Bd, of Regents, State Capitol, Pierre, S. D., has plans under way for new steam power plant for heating service at University of South Dakota, Vermillion, estimated to cost about $150,000, with equipment. Hugill, Blatherwick & Fritzel, Sioux Falls, S. D., are architects.

Tenn., Knoxville—Sanford-Day Iron Works, Inc., 612 Dale Ave., mine cars, wheels, sheaves and other heavy machinery, plans addition to boiler house, with installation of additional equipment for increased capacity. Work will be carried out in connection with expansion and improvements in plant, entire project to cost approximately $100,000.

Texas, Fort Worth—American Cyanamid Co., industrial chemicals, etc., plans installation of electric power equipment in connection with expansion in local plant, used primarily for production of fluid catalyst powder. A new processing building and other structures will be built. Cost estimated about $1,000,000. Main offices are at 30 Rockefeller Plaza, New York, N. Y.

Texas, San Antonio—City Public Service Bd., 201 North St. Marys St., has plans maturing for new addition to municipal power plant, to be used for auxiliary service, estimated to cost about $1,000,000, with equipment. Gibbs & Hill, Inc., 460 Seventh Ave., New York, N. Y., is consulting engineer.

Va., Riverton—Northern Virginia Power Co., Hagerstown, Md., has plans under way for new steam-electric generating station in vicinity of Riverton, to be equipped for initial capacity of 30,000 kw. Installation will include a turbine-generator of that rating, high-pressure boilers and auxiliary equipment. Project will include new transmission line for connection with present high-tension system, power substations and other operating facilities. Cost reported over $5,000,000. Sanderson & Porter, 42 Broadway, New York, N. Y., are consulting engineers.

Wash, Arlington—Puget Sound Power & Light Co., White Bldg., Seattle, Wash., plans new power substation in vicinity of Arlington, reported to cost about $160,000, with transformers, switchgear and auxiliary equipment. Work will begin at once.

Wash, Port Angeles—Public Utility District No. 1, Clallam County, Port Angeles, has plans under way for new hydroelectric generating station on Hogo River, on site known as Oxbow Bend, reported to cost close to $5,000,000 with concrete power dam, generating station, transmission and distribution lines. Henry Gray, White-Henry-Stuart Bldg., Seattle, Wash., is consulting engineer.

W. Va., Huntington—Standard Ultramarine Co., colors, bluing, etc., has plans for addition to boiler house at local factory, with installation of new 500-hp boiler and auxiliary equipment, coal bunker and dust-collecting system. Cost reported about $100,000. Rust Engineering Co., Clark Bldg., Pittsburgh, Pa., is engineer.

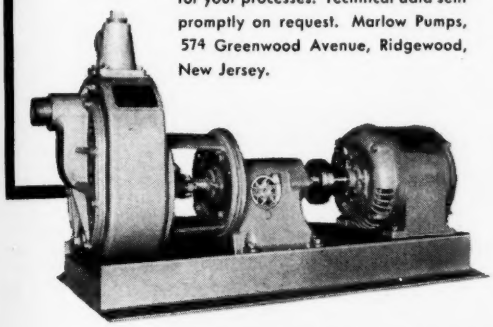
W. Va., Point Pleasant—Appalachian Electric Power Co., Roanoke, Va., has plans nearing completion for proposed steam-electric generating station at Point Pleasant, comprising a large multi-story steel frame building, with installation of two 125,000-kw turbine-generators, high-pressure boilers and auxiliary equipment. Transmission line will be built for connection with company high-tension system. Ohio Power Co., Canton, Ohio, also will secure certain power supply from new station. Construction will begin soon.

Wis., Green Bay—Wisconsin Public Service Corp., Green Bay, will begin work soon on superstructure for proposed addition to local Bayside steam-electric generating station. Installation will include new turbine-generator and accessories, high-pressure boiler and auxiliary equipment. Cost estimated about $5,250,000. Public Utility Engineering & Service Co., 231 South La Salle St., Chicago, Ill., is consulting engineer.

DEPARTMENT OF TECHNOLOGY
BUFFALO LIBRARY

THIS CENTRIFUGAL PUMP LIFTS HIGH PRIMES ITSELF

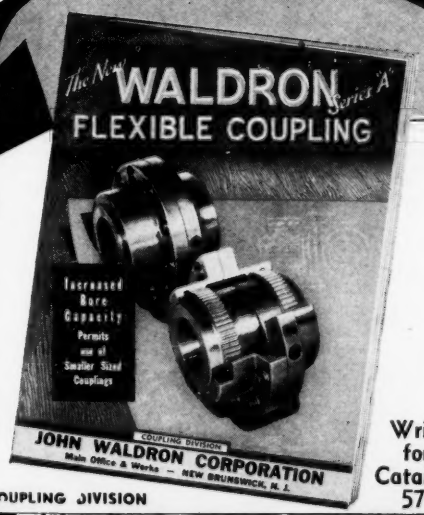
Marlow Self-Priming Centrifugals prime *automatically* on suction lifts as high as 25 feet. Handle water, coolants, chemical solutions, volatile fluids, liquids containing abrasives, liquids with viscosities to 500 S.S.U. Do not vapor-lock. 1½ to 10-inch sizes; 15 to 3500 GPM. Investigate Marlow pumps for your processes. Technical data sent promptly on request. Marlow Pumps, 574 Greenwood Avenue, Ridgewood, New Jersey.



MARLOW PUMPS

Manufacturers of Quality Pumps Since 1924

Let this catalog show you the BEST buy in COUPLINGS


The New WALDRON Series "A"
FLEXIBLE COUPLING
Increased Bore Capacity
Permits use of Smaller Sized Couplings
COUPLING DIVISION
JOHN WALDRON CORPORATION
Main Office & Works — NEW BRUNSWICK, N. J.

Proved by Sales

Write for Catalog 57

COUPLING DIVISION

JOHN WALDRON CORP.

Main Office and Works
New Brunswick, New Jersey

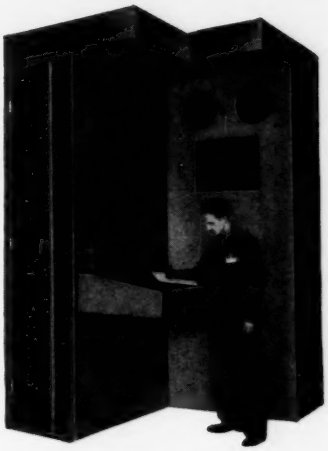
COUPLINGS

Falstrom presents

A NEW FACT-FINDING SERVICE!

on

PANEL BOARDS
★
INSTRUMENT PANELS
★
SWITCH BOARDS
★
CONTROL CUBICLES



"L" SHAPED CUBICLE WITH MONITOR'S DESK AND CANOPY LIGHTING

From FALSTROM ENGINEERING FILES

Falstrom engineers have designed and built so many control projects in all types of work that they have amassed a valuable background of experience for application in any field—

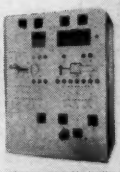
PUBLIC UTILITIES • POWER PLANTS
MANUFACTURING • COMMUNICATIONS
PETROLEUM REFINING • PROCESSING

This experience can be profitable to you in planning your next panel or cubicle job. You may require a simple, conventional set-up or a design which includes such extra details as:

Consoles • Lighting • Special Insulation
Clock Panels • Monitor Desks • Air Filtering
Grounding • Rolling Doors • Color Panels
Mimic Flow Diagrams • Knock-Down Cubicles

Many of these features together with designs and dimensions on STANDARD UNITS are included in Falstrom Technical Bulletins.

Please ask for Catalog 119-J.



HEAVY PANEL WITH MIMIC FLOW DIAGRAM

COMMUNICATIONS EQUIPMENT CABINET

HEAVY DUTY PUBLIC UTILITY CUBICLES

DESIGNERS.. ENGINEERS.. BUILDERS..

FALSTROM COMPANY

Steel Housings since 1870

7 FALSTROM COURT • PASSAIC • NEW JERSEY

MANUFACTURERS' NEWS

(Continued from page 164)

since 1933, has been appointed chief engineer. He succeeds C. S. Huntington, who has retired because of ill health.

H. Walter Regensburger, who has been assistant to the vice-president in charge of engineering, at executive offices, Chicago, since 1944, has been appointed divisional engineer in charge of estimate-engineering at the Pershing Road plant.

Eugene P. Berg, who has served as assistant to the president since the recent death of E. L. Berry, vice-president in charge of production, has been appointed general superintendent at the Pershing Road plant.

Joseph C. Spence, who has been general superintendent at the Pershing Road plant since 1942, has been appointed assistant to Harold L. Hoefman, the recently announced vice-president in charge of manufacturing, located at executive offices, 307 N. Michigan Ave., Chicago.

The manufacturing capacity of the Power Factor Division of Cornell-Dubilier Electric Corp. will be practically doubled with the completion of an additional plant of 41,000 sq ft in area, according to a recent announcement.

The Aldrich Pump Co of Allentown, Pa., recently announced that the Petroleum Machinery Co., 30 Rockefeller Plaza, New York City, who has represented Aldrich Pump Co. in the petroleum export field, has been appointed industrial representative in the New York area. This company will handle all Aldrich products in the industrial field. The marine field will continue to be represented by William O. Mulheron, 11 Broadway, New York City.

Conversion of the Missouri Ordnance Works near Louisiana, Mo., from synthetic ammonia to synthetic liquid fuels production, started late in 1945 by the Bureau of Mines, again is under way following an extended delay caused when the plant was taken back by the War Department for emergency production of ammonia for fertilizers.

Ward Leonard Electric Co., Mount Vernon, N. Y., announces the appointment of Durling Electric Co., 2002 St. Paul St., Baltimore 18, Md., as its representative in Virginia, south central Pennsylvania, Maryland, except for the Washington area, and Delaware south of Wilmington.

Electric Machinery Mfg. Co., Minneapolis, Minn., announces the establishment of a new sales office in Dallas, Tex., to handle their line of large motors, generators, and control equipment. H. L. Renking, formerly manager of the E-M office at Pittsburgh, will be in charge.

David Gordon & Co., Inc., Chemical, Mechanical and Industrial Engineers, 29 Broadway, New York City, announce the election of Mr. Gordon, previously with the M. W. Kellogg Co. and the Interchemical Corp., to the Presidency of the company as of July 16, 1947. The company is actively engaged in handling both domestic and foreign business.

Cutler-Hammer, Inc., Milwaukee, has announced new and expanded quarters for its Cleveland office. The new office, located at 2010 East 46th Street, Cleveland 3, Ohio, provides improved facilities for the sale and distribution of the company's line of electrical products in the Cleveland area. R. J. Eckstein is Cleveland District Sales Manager. Announcement also has been made of a new branch sales office located at 107 North Franklin Street, Saginaw, Michigan. The new office has been opened to meet the increasing demand in that area for the company's varied lines of electrical apparatus. R. L. Hibbard will manage the new office as a branch of the company's Detroit District Sales Office.

MANUFACTURERS' *Personals*

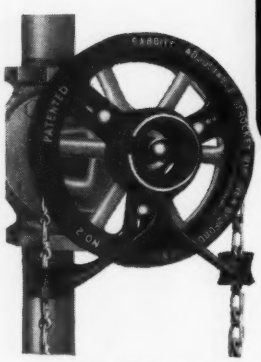
Chain Belt Co., Milwaukee, announces a change in its field force personnel affecting several of its branch offices. David B. Hill has joined the Atlanta office as district field-engineer. Orval Lorenz has joined the Dallas office. He was formerly with the Atlanta office as district field-engineer, and, prior to that, had taken our intensive training course at the Chain Belt and Baldwin-Duckworth factories in Milwaukee, Springfield, and Worcester. Charles Stanton has moved from the Detroit office to the Philadelphia office. Like Mr. Lorenz, Mr. Stanton had taken the training course at the Chain Belt and Baldwin-Duckworth factories.

The United States Gasket Co., Camden, New Jersey, announces the appointment of Harry F. Lea, of Buffalo, New York, as its Western New York District Representative. Mr. Lea's selling career has extended over a period of 22 years, the majority of which was as a salesman in the Industrial Division of the American Optical Co. of Southbridge, Massachusetts. In 1944, Mr. Lea organized the Buffalo Branch of the Continental Rubber Co. and served as Branch Manager. Mr. Lea will make his headquarters in Buffalo, his address being P.O. Box No. 41, Buffalo 16, New York.

Quaker Rubber Corporation, Philadelphia, Penna., announces the appointment of A. Harold Smith as New York District Sales Manager, and P. H. Potts as New York Branch Manager, with headquarters in New York City. Mr. Smith has served Quaker as Manager of their Belting Division and Assistant Sales Man-

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

Makes ALL Valves *INSTANTLY* Accessible!



Ten standard sizes take care of all types and makes of valves; fit valve wheels from 2 to 30 inches in diameter.

• Inexpensive BABBITT Sprocket Rims provide instant, handy control of overhead and other out-of-reach valves. Now — valves can be installed anywhere they should be, regardless of accessibility.

Babbitt Rims fit any valve, any style, with either rising or non-rising stems. Installed in a jiffy . . . simply by clamping directly onto hand wheel of valve. Do away with clumsy makeshift apparatus or specially-made chain wheels.

Distributors in All Principal Cities

Request illustrated Catalog Bulletin PP, prices and name of local distributor.

BABBITT STEAM SPECIALTY CO.
NEW BEDFORD, MASSACHUSETTS, U. S. A.

COSTLY HUMAN ERRORS ELIMINATED WHEN YOU MEASURE VALUABLE STORED LIQUIDS With

LIQUIDOMETER Tank Gauges

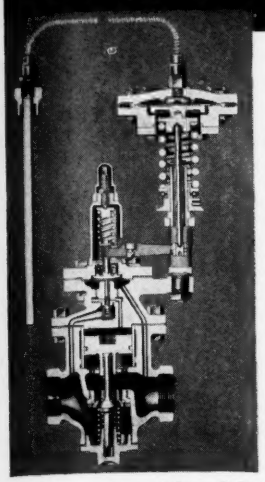
FOR GAUGING LIQUIDS OF ALL KINDS
100% AUTOMATIC
APPROVED BY UNDERWRITERS' LABORATORIES

WRITE FOR COMPLETE DETAILS

"LIQUIDS WORTH STORING ARE WORTH MEASURING"

THE LIQUIDOMETER CORP.
36-31 SKILLMAN AVE., LONG ISLAND CITY, L.I., N.Y.

Here's *Accurate* Temperature Control



This LESLIE Temperature Regulator, Class LTCO, is actually a Pressure Reducing Valve actuated by a thermostatic element.

Install the bulb in the fluid being heated and small temperature changes will actuate the vapor pressure type element automatically, changing the setting of the regulating valve, and the outlet steam pressure.

The maximum outlet steam pressure delivered by the regulator is adjustable from 10 psi. to within 15 psi. of inlet pressure.

A typical installation on a fuel oil heater controls oil temperature within one or two degrees under maximum fluctuations of demand.

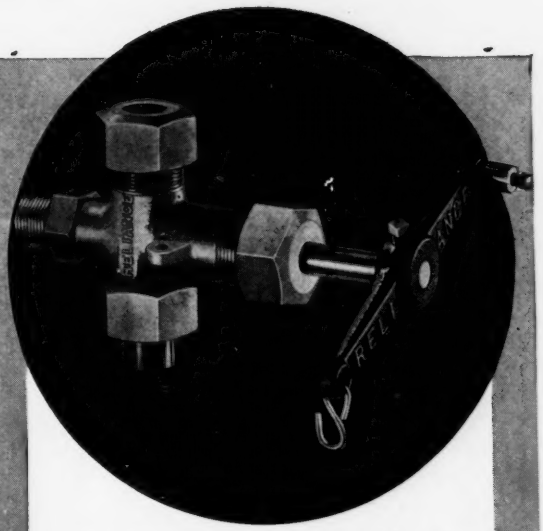
Write for Bulletin 464 for the complete story.

Lowest Overall Cost per Operating Year

ESTABLISHED 1900 LESLIE CO.

LESLIE CO.
257 Grant Ave., Lyndhurst, N. J.

PRESSURE REDUCING VALVES • • PRESSURE CONTROLLERS
PUMP GOVERNORS • • • TEMPERATURE REGULATORS
SELF CLEANING STRAINERS • • LESLIE-TYFON WHISTLES



For Leak-Proof Gage Service Use RELIANCE GAGE VALVES

Reliance Gage Valves are dependable in toughest boiler room service—provide insurance against loss of valuable production time, and troublesome expensive maintenance. You have the choice, to suit your needs, of Valves in various styles and materials, for low or high pressure service.

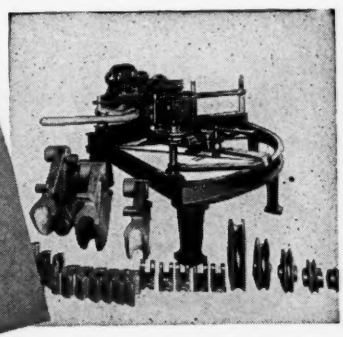
Reliance exclusive designs and precision manufacture assure you rugged, efficient gage service and long, low-maintenance valve life. Write for Bulletin 418 today.

THE RELIANCE GAUGE COLUMN CO.
5902 Carnegie Avenue, Cleveland 3, Ohio

Reliance

BOILER SAFETY DEVICES SINCE 1884

BENDS PIPE EASILY AND QUICKLY INTO ALL SHAPES



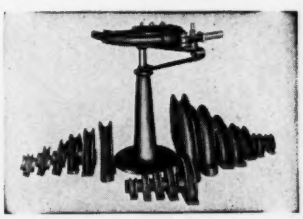
"American"

COLD PIPE, CONDUIT and TUBE BENDING MACHINES

Twelve types to select from. Hand operated capacities ¼ to 6" inclusive. Motor operated ¾ to 8" inclusive.

A few of Our More Than 12,000 Customers:

Kaiser Shipbuilding Co.; Bethlehem-Hingham Shipyards; Portsmouth Navy Yard; Moore Drydock Co.; Stone & Webster Engineering Corp.; E. I. du Pont deNemeurs & Co.; West Penn Power Co.; Illinois Central Railroad; Federal Pipe & Supply Co.; Alabama Drydock Co.; Westinghouse Elec. & Mfg. Co.; Todd-Bath Shipbuilding Co.



Write Air Mail for printed matter.

"American" PIPE BENDING MACHINE Company INC

Quick Deliveries
16 FURNACE ST.
POULTNEY, VT.

A Little GAMLENOL MAKES THIS BIG Difference IN FUEL OIL

Untreated oil readily reacts with water to form an emulsion, or sludge.

Gamlenol-treated oil does not combine with water; sludge formation is prevented.

POUR a comparatively small amount of Gamlenol into the fuel tank, through fill line or sounding pipe. The effect is immediately noticeable, for Gamlenol dissolves sludge throughout the system, clearing lines, coils, preheaters, strainers, injectors, burner tips. And, its regular use in small quantities prevents re-accumulations. Gamlenol greatly improves atomization and combustion, and increases firing efficiency, which results in more heat and power from every gallon of oil.

Gamlenol is safe, non-explosive, approved as ships' stores. It contains no acid, soda ash, caustic soda, or alkalis.

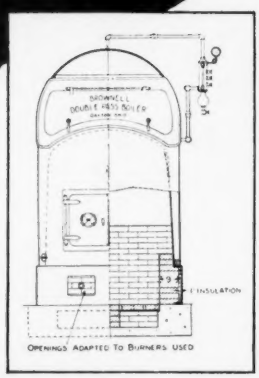
Ask nearest Gamlen representative for details, or write for Bulletin 455.

GAMLEN CHEMICAL COMPANY

1469 Spring Garden Avenue—Pittsburgh 12, Pa.
195 San Bruno Avenue—San Francisco 3, Calif.
11 Broadway—New York 4, N. Y.

● Service and Stocks in All Principal Cities and Ports

BUILT FOR OIL OR GAS FIRING



Drawing of Brownell Double-Pass Firebox Boiler arranged for oil or gas firing.

Brownell Double-Pass Firebox Boilers are especially designed to burn volatile fuels. When so ordered, they are arranged for oil or gas burners.

Furnace volume and fire-tube systems in these boilers are balanced and generous to promote economical fuel consumption. Surpassing mere code requirements, Brownell engineers incorporate in the boilers many factors which increase efficiency and promote length of service.

Detailed information is given in our bulletin No. RM-1. Ask for a copy. When we answer, we'll give you the name of our nearest agent.

THE BROWNELL COMPANY

420 N. FINDLAY ST., DAYTON 1, OHIO

ager in terirtory contacts. Mr. Potts resumes his office after his temporary wartime activities in special sales work for Quaker.

Frederick J. Riker, former manager, Forge Blanks Division, Crucible Steel Co. of America, has been named president of Livingstone Engineering Co., (formerly Speedyelectric Engineering Co.) electric steam boiler manufacturers of Boston, Mass. Mr. Riker thus re-affiliates himself with steam and power engineering, since his first job after graduation from Stevens Tech was on the personal laboratory staff of Thomas A. Edison. He became assistant chief engineer of the Edison Laboratories and later manager, power service division, Thomas A. Edison Industries.

A. L. Nelson, president, Nelson Electric Corp., 1620 Euclid Street, Santa Monica, Calif., one of the West Coast's leading manufacturers of transformers, recently announced the appointment of H. N. Leuckel as purchasing agent for the new corporation. Mr. Leuckel, who resides at 1738½ West 56th Street, Los Angeles, was formerly chief purchasing agent for Air Communications, Inc., Kansas City.

Donald N. Watkins, president of Laclede-Christy Clay Products Co., has announced the appointment of Julius A. Kayser as assistant to the president. Mr. Kayser, who was born and educated in Copenhagen, Denmark, has been with the company for the past 24 years. He has served in various capacities in the research, operating and sales departments.

D. A. Griffin has been named assistant to J. W. McMullen, general manager of Allis-Chalmers' Pittsburgh Works. Mr. Griffin, who attended Carnegie Institute of Technology, has been associated with the Allis-Chalmers transformer section at the Pittsburgh plant since 1927. Prior to joining Allis-Chalmers he was with the U. S. Bureau of Mines.

D. S. Walker, vice-president of Combustion Engineering Co., New York, was elected president of the U. S. Naval Academy Alumni Association at a recent meeting of the board of trustees at Annapolis, Md. A member of the Academy class of 1924, Mr. Walker has been a trustee and vice-president of the Alumni Association for the past two years.

Ray T. Jenkins has been promoted to assistant general manager of the marley Co., Inc. Mr. Jenkins entered the Marley organization in 1933 as sales engineer, and since then has headed the Dallas, Tulsa and Houston offices and has served as general sales manager since 1944 when he came to the Kansas City office.

Onni Lindfors, who has been in the past a design engineer in the electrical division of Fairbanks, Morse & Co., Beloit, works, has been appointed chief electrical engineer of the company's Freeport, Ill., plant where the new avial air gap motor is being manufactured, according to a recent announcement.

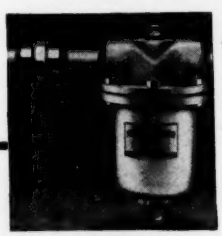
Burlington Inst. Co. announces the appointment of Frederick A. Mayer as its representative to handle the Burlington line. Mr. Meyer's headquarters will be at 207 East Michigan St., Milwaukee 2, Wis.

WITH FITTINGS SO SCARCE save 7 per trap with SUPER-SILVERTOP

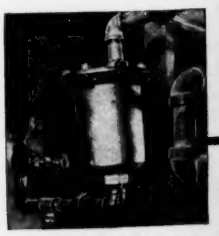
Pipe fittings are so hard to get that it makes sense to save as many as possible on every installation. When you use Super-Silvertop Steam Traps, you save up to nine fittings per trap over the ordinary inverted bucket trap design. But that's not all. The saving in installation time (as much as 60 minutes per trap) is not to be "sneezed at" these days. Besides, Super-Silvertop gives you these savings throughout the size and pressure range—in the big No. 24 and 25 traps and steel traps as well as in the smaller and lower pressure ranges.

Send for your free copy of the book "How To Choose a Steam Trap." Gives complete information and much helpful data for everyday use.

THE V. D. ANDERSON COMPANY
1939 WEST 96th STREET • CLEVELAND 2, OHIO



Super-Silvertop showing one nipple and one union needed.



Conventional trap using seven fittings and two unions.